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ABSTRACT

Mothers' education is frequently found to be positively correlated with child health and nutrition in developing countries, and yet the causal mechanisms are poorly understood. An examination was conducted of the role played by three mechanisms in this process: formal education that directly teaches health knowledge to future mothers; literacy and numeracy skills acquired in school that assist future mothers in diagnosing and treating child health problems; and exposure to modern society from formal schooling that makes women more receptive to modern medical treatments. Participants were 2,171 households in Morocco that completed the battery of education achievement tests, including the "Enquete Nationale sur le Niveau de Vie des Menages." (National Survey on the Level of Life of Households). Mothers' health knowledge alone was found to be the crucial skill for raising child health. In Morocco, such knowledge is obtained primarily outside the classroom, although it is also obtained using literacy and numeracy skills learned in school; there is no evidence that health knowledge is taught directly in schools. This finding suggests that teaching of health knowledge skills in Moroccan schools could substantially raise child health and nutrition in Morocco. (JPB)

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LSMS

Living Standards
Measurement Study
Working Paper No. 128

# How Does Schooling of Mothers Improve Child Health?

## Evidence from Morocco

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# How Does Schooling of Mothers Improve Child Health?

## The Living Standards Measurement Study

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LSMS Working Paper
Number 128

# How Does Schooling of Mothers Improve Child Health?

Paul Glewwe

The World Bank
Washington, D.C.

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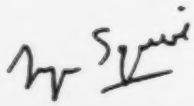
## Foreword

Women's education can contribute to economic development in several different ways. One way is through the relationship between mothers' education and child health. Better educated mothers tend to have healthier children. From a policy perspective, one would like to know what it is about education that leads to healthier children. This paper examines this question using data from the 1991 Morocco Living Standards Measurement Study household survey. It identifies mothers' health knowledge as playing the key role in raising child health and shows how education raises health knowledge. More generally, this paper demonstrates how detailed household survey data can be used to assist in poverty formulation in developing countries.



Lyn Squire, Director
Policy Research Department

## Abstract

Mothers' education is often found to be positively correlated with child health and nutrition in developing countries, yet the causal mechanisms are poorly understood. Three possible mechanisms are: (1) formal education directly teaches health knowledge to future mothers; (2) literacy and numeracy skills acquired in school assist future mothers in diagnosing and treating child health problems; and (3) exposure to modern society from formal schooling makes women more receptive to modern medical treatments. This paper uses data from Morocco to assess the role played by these different mechanisms. Mothers' health knowledge alone appears to be the crucial skill for raising child health. In Morocco, such knowledge is primarily obtained outside the classroom, although it is obtained using literacy and numeracy skills learned in school; there is no evidence that health knowledge is directly taught in schools. This suggests that teaching of health knowledge skills in Moroccan schools could substantially raise child health and nutrition in Morocco.

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# I. Introduction

Child health and nutritional status is a key indicator of the quality of life in developing countries. Mothers' years of education is often positively associated with improved child health (cf. Behrman, 1990). There are a variety of mechanisms through which mothers' education could raise child health status: (1) Direct acquisition of basic health knowledge in school may provide future mothers with information useful for diagnosing and treating child health problems; (2) Literacy and numeracy skills learned in school may enhance mothers' abilities to treat child illnesses, conditional on health knowledge, and also should help mothers increase their stock of health knowledge after leaving school; and (3) Exposure to modern society in general via schooling may change women's attitudes toward traditional methods of raising children and treating their health problems.

This paper attempts to assess the relative importance of these three mechanisms, using the 1990-91 Moroccan Enquête Nationale des Niveaux de Vie des Menages (ENNVM). Knowledge of the relative importance of these mechanisms can have important policy implications. For example, if the main impact of education comes from raising mothers' basic health knowledge, such knowledge should be taught in schools as early as possible (i.e. before girls drop out) and perhaps should also be taught in special education courses for women of child-bearing age who have already left school.

The paper is organized as follows. Chapter II reviews, in broad terms, the impact of mother education on child health and presents a model of the determinants of child health. Chapter III discusses the data and some estimation issues. Chapter IV presents the empirical results. Chapter V decomposes the total impact of mothers' schooling on child health. Chapter VI sums up the results.

## II. Mother Education and Child Health

### General Discussion

Figure 1 provides a schematic framework for thinking about the determinants of child health and nutritional status. As seen at the bottom of that figure, child health is ultimately determined by three distinct sets of factors: 1. Health and nutritional inputs provided by the household (arrow k); 2. The local health environment (arrow h); and 3. The child's health endowment (arrow j). Health and nutritional inputs provided by the household include prenatal care, duration of breastfeeding, use of breastmilk substitutes such as infant formula, calories from adult foods (for weaned children), medicines and medical care, household water sources and sanitary facilities, and other hygienic conditions. The local health environment consists of all community characteristics that directly affect child health and are generally beyond the control of the parents, such as prevalence of parasites and the incidence of contagious disease among the general population. Finally, the child health endowment consists of all components of the child's genetic inheritance that have implications for his or her health.

Household health and nutritional inputs are determined by household decisions that reflect the characteristics of the household, the local community and the child, such as (initial) household assets, parental schooling, community economic and health-related characteristics (such as the availability and prices of medical services), and each child's health endowment. This paper focuses on parental schooling, particularly mother schooling; father's schooling, apart from its income effect, is less likely to be important for maintaining children's health.

Schultz (1984) argues that mothers' education can influence child health in five ways:[1] (1) Education may lead to a more efficient mix of health goods used to produce child health; (2) Better educated mothers may be more effective at producing child health for a given amount and mix of health goods; (3) Schooling can affect parents' preferences in systematic ways—for example, educated mothers tend to opt for fewer but healthier children; (4) Education raises the opportunity costs of time, which tends to increase the time mothers spend working outside the home and thus reduces time devoted to child care—this effect of schooling could reduce child health by reducing both maternal time devoted to child care and duration of breastfeeding; and (5) More schooling should raise family incomes, either through higher wages or increased productivity in self-employment, which should improve child health status. In Figure 1, the latter three pathways are represented by the pathways a-a' (and also a-a'' and a-a'''), cde' (via c-c''' and d) and cdef (via c-c'''-cde and d-cde), respectively. Yet the first two, which reflect the direct effect of the health knowledge and cognitive skills that education imparts, have received less attention in the literature. What is it about schooling that makes mothers more efficient in producing child health?

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1. Schultz's framework is primarily concerned with child mortality. Yet broadening it to include other, less severe, aspects of child health does not require significant modification.

# Figure 1: Determinants of Child Health

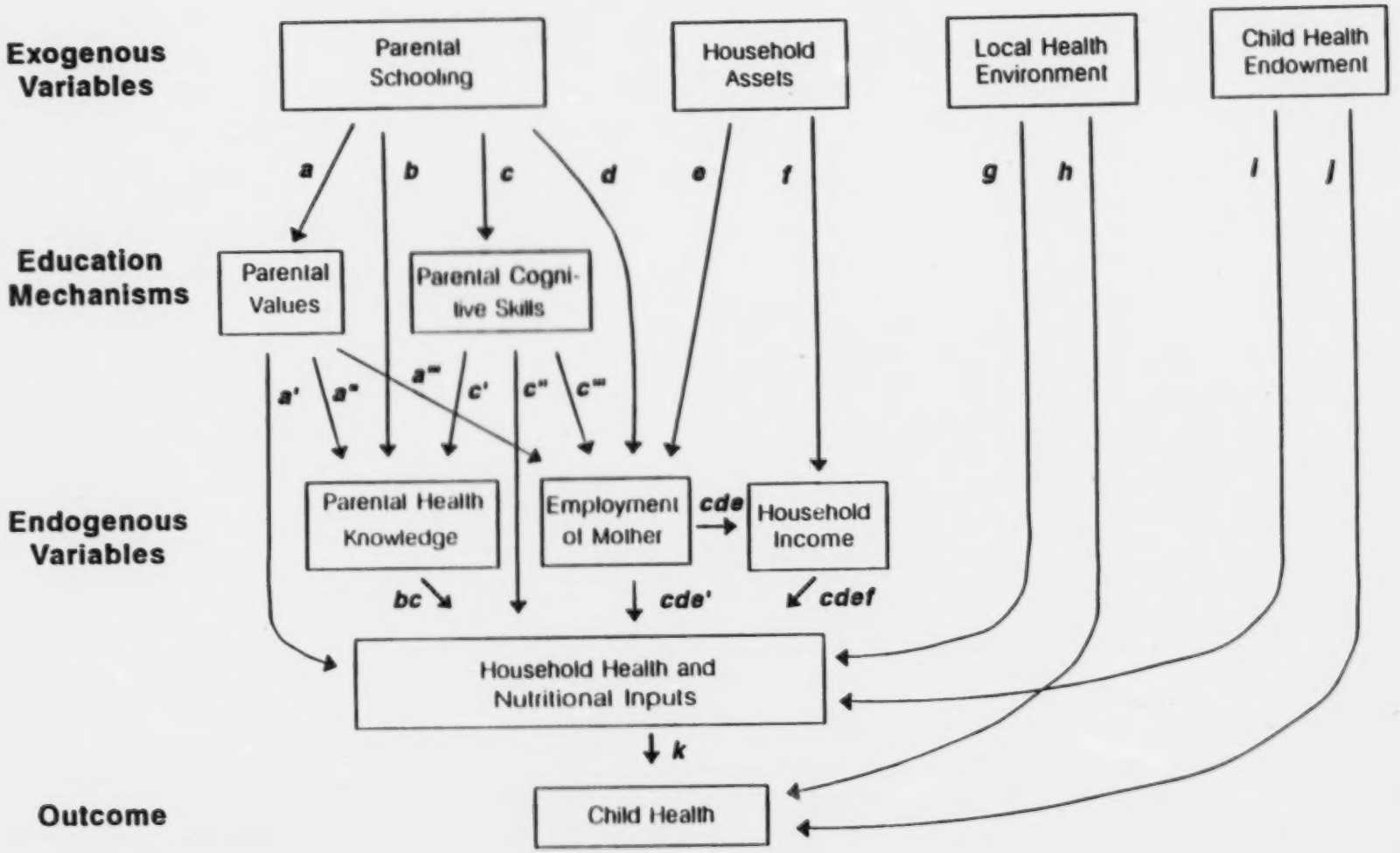

Figure 1 presents two mechanisms through which schooling could influence the choice of health and nutritional inputs via the knowledge and skills it provides.[2] First, school curricula may directly teach effective health care practices to students. This pathway is denoted by b-bc. For example, the impact of diarrhea on child health can be minimized using oral rehydration therapy (ORT), which can be taught even in primary schools.[3] Second, schooling can influence child health inputs through the cognitive skills imparted, such as literacy and numeracy. Literate mothers are better able to read written instructions for treating of childhood diseases, and numeracy enables mothers to better monitor illnesses and apply treatments. This direct effect is shown by c-c" in Figure 1. Literacy and numeracy also enable mothers to increase their health knowledge by enabling them to gather information from written sources. This indirect effect is path c-c'-bc in Figure 1.

Figure 1 also depicts how factors other than schooling influence child health. Household physical assets raise household incomes (via e-cde and f), which should have a positive effect on both nutritional inputs (e.g. calories) and environmental conditions around the home (both via cdef). The choice of health and nutritional inputs will also be affected by factors associated with the supply of these inputs in the community (arrow g). For example, the availability and quality of health and non-health community facilities affects the decisions households make regarding health and nutritional inputs. Finally, the child's health endowment will also affect household health and nutritional inputs (via arrow i), since more sickly children usually receive larger amounts of health and nutritional inputs.

**Recent Empirical Evidence**

Many recent studies have examined the impact of mothers' (and fathers') education on child health. For comprehensive reviews of the literature see Behrman and Deolalikar (1988), Behrman (1990), and Strauss and Thomas (1995). The discussion here will be limited to an overview of a few recent studies, focusing on the impact of mothers' education on height-for-age and weight-for-height.

Studies of the determinants of child height and weight in many countries have found positive effects of mothers' education. Most of these studies presented reduced form estimates, but a few went further, examining the pathways by which mothers' education improves child health. In the Philippines, Barrera (1990) found that better educated mothers tended to wean their children sooner, but they compensated for this shortened breastfeeding time with better

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2. The distinction between pathways (1) and (2) in the previous paragraph is that the first concerns an efficient mix of physical health inputs (e.g. medicines) while the second adds efficient use of non-physical inputs (such as care given to the sick child). In this paper, the distinction between physical and non-physical inputs is not of primary interest, rather the emphasis is on the different types of knowledge and skills learned in school, and how they affect efficient use of both types of inputs.

3. See Cash (1983) on teaching ORT in primary schools in Indonesia.

care; overall, their children were healthier as measured by higher height-for-age z-scores.[4] The only published study that focuses on the "information processing" attributes of schooling is by Thomas, Strauss, and Henriques (1990), which used Brazilian data that included variables for whether a woman reads a newspaper, listens to the radio, or watches television. Mothers' schooling was not significant when dummy variables were included for these "information processing" activities; the newspaper and radio variables were significant in rural areas but only the television variable was significant in urban areas.

Perhaps the most interesting studies are those based on the Cebu Longitudinal Health and Nutrition Study. Several studies using these data have attempted to model the pathways by which exogenous variables influence child nutritional status and morbidity. The Cebu Study Team (1991, 1992) found that mothers' education leads to improved waste disposal and higher non-breastmilk calorie intake, both of which reduce the incidence of diarrhea. High maternal education also leads to earlier weaning, which can increase episodes of diarrhea, but the net effect of higher maternal education is to decrease the incidence of diarrhea.

An important critique of findings that mothers' education improves child health is the hypothesis that education simply reflects unobserved maternal characteristics. Wolfe and Behrman (1987) used Nicaraguan data on mothers' siblings to control for unobserved family fixed effects. They found that applying these controls leaves no significant effect of mothers' education on child anthropometric status. However, Strauss (1990) found in Cote d'Ivoire that mothers' education raises child height-for-age and weight-for-height, even after using family fixed effects estimators.

In summary, there is considerable evidence that mothers' education improves child health, and some evidence on how this occurs. Still, there are no studies that distinguish between the literacy and numeracy impacts of schooling and other, more general, impacts. Also, there are no studies that attempt to directly assess the impact of mothers' health knowledge on child health.

**A Model of the Impact of Schooling on Child Health Status**

In this subsection the scheme in Figure 1 is presented more formally. This is necessary because estimation of the impact of mothers' schooling on child health requires careful consideration of which variables may be endogenous. The model begins at the time today's parents finished their schooling. Assume that years of schooling of today's parents was a choice made primarily by their own parents, so that for today's parents it is exogenous. This assumption is reasonable for Morocco, where average schooling for adult men and woman between the ages of 18 and 65 is only 4.7 and 2.3 years, respectively. Similarly, skills and

4. Height for age z-scores, which will be used in the empirical work below, are based on fitting a standard normal distribution to the growth curves of a healthy population of children. A child with a z-score of zero is exactly at the median in terms of height for age, while children with positive (negative) z-scores are taller (shorter) than average. Low height for age z-scores indicate stunting due to repeated episodes of malnutrition over the life of the child, while low weight for height z-scores indicate wasting (weight loss) due to a current episode of malnutrition (cf. Gibson, 1990).

values possessed when leaving school are also assumed to be exogenous. Nevertheless, investigation of the pathways by which parental schooling can raise child health requires specification of the processes that determine these skills and values:

$$(1) \quad L_{0i} = l_0(S_i, GE_i, Q_i, \mu_i, u_{0li})$$

$$(2) \quad N_{0i} = n_0(S_i, GE_i, Q_i, \mu_i, u_{0ni})$$

$$(3) \quad HK_{0i} = hk_0(S_i, GE_i, Q_i, \mu_i, u_{0hki})$$

$$(4) \quad V_i = v(S_i, GE_i, Q_i, V_G, u_{vi}).$$

Equations (1) - (4) are production functions for skills and values acquired in school by the parents of child i. The zero subscripts in equations (1), (2) and (3) denote skill levels at the time schooling was completed. Literacy ($L_{0i}$), numeracy ($N_{0i}$) and health knowledge ($HK_{0i}$) of today's parents when they finished their schooling were produced by their years of schooling ($S_i$), the education levels of their parents ($GE_i$, where G denotes grandparent), school quality ($Q_i$), their innate learning ability ($\mu_i$), and less important residual factors ($u_{0i}$). All four variables have positive impacts; learning increases by attending school longer ($S_i$), being assisted by a better educated parent ($GE_i$), attending a higher quality school ($Q_i$), and having a high ability to learn ($\mu_i$).

Equation (4) shows how schooling affects values. Ability to learn is assumed to have no affect; instead, the values of the parents' parents ($V_G$) affect them. An important value to consider is "tastes" for child "quality". Schools may actively teach children that small families are desirable because smaller families enable parents to "invest" more in each child. By changing students' values, schooling could reduce malnutrition even if children acquire no skills at all from their schooling. Equation (4) also differs from equations (1), (2) and (3) because it represents values today, not just values when leaving school, which implies that values do not change significantly after finishing school. In contrast, the skills involved in the first three equations may change after an individual leaves school. For example, reading ability may deteriorate for individuals leaving school with weak reading skills, particularly those whose daily activities involve little or no reading.

What determines current literacy and numeracy? Assume that they are determined by initial skills, elapsed time since leaving school ($A_i$-$S_i$-6, where $A_i$ is parent's age), and some residual factors:

$$(5) \quad L_i = l(L_{0i}, A_i\text{-}S_i\text{-}6, u_{dli})$$

$$(6) \quad N_i = n(N_{0i}, A_i\text{-}S_i\text{-}6, u_{dni})$$

While $L_{0i}$, $N_{0i}$ and $A_i - S_i - 6$ in equations (5) and (6) are all exogenous, given the reasoning above, the residual terms may lead to estimation problems. In particular, the residuals may reflect tastes concerning career choices; a person predisposed to white collar work may obtain a job that uses literacy and numeracy skills regularly, which could maintain or even improve

those skills. For purposes of estimation, the dependence of "drift" in skills on employment choices is worrisome because it suggests that current literacy and numeracy skills may be endogenous. However, this is unlikely to be important for Morocco. First, Moroccans rarely change occupations,[5] which implies that decisions affecting drift were made soon after schooling, so that subsequent drift is effectively predetermined. Second, few jobs in Morocco make use of literacy skills; in the 1990-91 ENNVM data only 13% of employed respondents report using their ability to read more than once per week on the job. Third, of the 13% of adults who use their reading skills on the job, most (72%) also report using them regularly at home. Thus, everyday use of these skills may not be strongly linked to employment. Finally, the number of women who use literacy skills on the job is even lower since fewer of them work,[6] and it is women's skills that are the primary focus of this study. These arguments support the assumption that current literacy and numeracy skills are largely predetermined. In particular, these skills are unlikely to change in response to health outcomes of children and thus can be considered exogenous when of estimating their impact on child health. Nevertheless, this exogeneity assumption will be tested in the empirical work presented below.

The evolution of health knowledge is more complex than that of literacy or numeracy. First, parents can increase their health knowledge by reading books, newspapers and other written material. Second, exposure to other mass media, such as radio or television, can raise parental health knowledge (as in Thomas, Strauss and Henriques, 1990). Third, parents can obtain specific health knowledge from friends or relatives who have experienced similar health problems. Finally, parents' with chronically ill children have a strong incentive to increase their health knowledge in order to better care for their children. All of this suggests that health knowledge should *not* be treated as an exogenous determinant of health care decisions. Thus the evolution of health knowledge after completing schooling can be specified as:

$$(7) \qquad HK_i = hk(HK_{0i}, A_i\text{-}S_i\text{-}6, L_i, N_i, M_i, R_i, \epsilon_i, u_{dhki})$$

where $M_i$ represents exogenous exposure to media (radio, newspapers, television, etc.), $R_i$ is health knowledge potentially available from relatives or friends, and $\epsilon_i$ is a child's health endowment.

Substitution of (1), (2) and (3) into (5), (6) and (7), respectively, yields the following equations, all of which will be estimated in the empirical part of this paper:[7]

$$(5') \qquad L_i = l(S_i, GE_i, Q_i, A_i\text{-}S_i\text{-}6, \mu_i, u_{li})$$

---

5. Of all employed people in the 1990-91 ENNVM between the ages of 30 and 39, half report that they have worked in their current occupation for 11 or more years and three fourths have worked for 7 or more years. The analogous figures for individuals aged 40 to 49 are 20 and 11, respectively.

6. Labor force participation for men aged 18 to 65 was 70%; for women the figure is only 28%.

7. The notation for these three functions (i.e. l, n and hk) has been retained even though, technically, these are not the same functions as in equations (5), (6) and (7).

(6') $N_i = n(S_i, GE_i, Q_i, A_i\text{-}S_i\text{-}6, \mu_i, u_{ni})$

(7') $HK_i = hk(S_i, L_i, N_i, GE_i, Q_i, A_i\text{-}S_i\text{-}6, M_i, R_i, \epsilon_i, \mu_i, u_{hki})$

Strictly speaking, equations (5') and (6') are no longer production functions because they incorporate the "drift" in equations (5) and (6). They can be interpreted as reduced form equations with the qualification that the dependant variables are pre-determined, as opposed to (currently) endogenous. That is, an occupational choice made in the past led to "equations of motion" for these skills that set them on time paths that are unlikely to be altered. Most importantly, today's decisions concerning child health are not jointly endogenous with literacy and numeracy because they are made after child health endowments ($\epsilon_i$) are observed, while the decisions that determine today's literacy and numeracy were made before observing child health endowments. In contrast, the health knowledge equation (7') shows the reduced form determinants of a (currently) endogenous variable.

Turn now to the mechanisms by which schooling affects child health. The starting point is the health production function that corresponds to the box at the bottom of Figure 1:

(8) $H_i = h(HI_i, E_i, \epsilon_i)$,

where $H_i$ is the health of child i, $HI_i$ is a comprehensive set of health inputs, $E_i$ represents variables concerning the local health environment and $\epsilon_i$ is the health endowment of the child. Equation (8) is a technological relationship (i.e., a health production function) that parents take into account as best they can when making decisions that affect their children's health. While the local health environment ($E_i$) and the child's health endowment ($\epsilon_i$) are outside the control of the household,[8] health and nutritional inputs ($HI_i$) are determined by household choices.

Figure 1 shows that child health inputs depend on parents' values ($V_i$), health knowledge ($HK_i$), and literacy and numeracy skills ($L_i$ and $N_i$, respectively), all of which are in part determined by years of schooling, as explained above. In addition, child health inputs depend on mothers' time spent at home ($MT_i$), the complement of time spent working outside the home,[9] household income ($Y_i$), and again the local health environment ($E_i$) and health endowment of the child ($\epsilon_i$):

(9) $HI_i = hi(V_i, HK_i, L_i, N_i, MT_i, Y_i, E_i, \epsilon_i)$.

---

8. This assumes that the local health environment is not determined by migration decisions, and that households cannot pressure local authorities to improve the local health environment. The former assumption is supported by migration data from the 1990-91 ENNVM; only 0.5% of respondents report that the main reason for their most recent move was "health reasons". The latter assumption is harder to check, but it is plausible for Morocco, because health care provision is highly centralized, with almost all funds outside the control of local governments (see World Bank, 1994a).

9. Father's time spent working (and at home) is assumed to vary little across households.

The last two arguments in equation (9), $E_i$ and $\epsilon_i$, are included because parents may adjust the health inputs provided to their child based on the effects of the local health environment and the child's health endowment. For example, a child in a relatively healthy environment may not require as much direct health inputs as a child facing a poor health environment.

Equation (9) contains three endogenous variables: health knowledge (HK), mothers' time at home (MT) and household income (Y). Thus it is a conditional demand function and can be estimated only if suitable instrumental variables are found for these endogenous variables. The determinants of current health knowledge are given in equation (7') above. Clearly, there are several candidates for instrumental variables, but a full discussion is deferred to Chapter III below.

The determinates of mothers' time spent working ($MT_i$) and household income ($Y_i$) are:

(10) $MT_i = mt(S_i, Q_i, GE_i, T_i, A_i\text{-}S_i\text{-}6, XF_i, HA_i, \epsilon_i, \mu_i, u_{mti})$

(11) $Y = y(MT_i, S_i, S_{if}, Q_i, A_i\text{-}S_i\text{-}6, A_{if}\text{-}S_{if}\text{-}6, GE_i, GE_{if}, HA_i, u_{yi})$.

Equation (10) is a reduced form; all the explanatory variables are assumed exogenous. The time a mother spends at home depends on the value of her time in the labor market (which is a function of $S_i$, $Q_i$, $GE_i$, $A_i\text{-}S_i\text{-}6$, and $\mu_i$), her "tastes" for working ($T_i$), her extended family situation ($XF_i$), such as whether her (or her spouse's) parents are alive and in need of care, household assets ($HA_i$), and residual factors ($u_{yi}$). It also depends on her child's health endowment ($\epsilon_i$), since she may work less if her child is sick. Equation (11) shows household income ($Y_i$) as a function of mothers' time spent at home (the compliment of time spent working), mothers' and fathers' schooling ($S_i$ and $S_{if}$), the quality of that schooling ($Q_i$), the (potential) work experiences of both parents ($A_i\text{-}S_i\text{-}6$ and $A_{if}\text{-}S_{if}\text{-}6$), the schooling of both sets of grandparents ($GE_i$ and $GE_{if}$), household assets, and residual factors ($u_{iy}$).[10] Equation (11) is a conditional demand function because it depends on mothers' time spent working ($MT_i$) and can be estimated only if suitable instrumental variables exist for that variable.

Substitution of (9) into (8) yields the equation of primary interest in this paper:

(8') $H_i = h'(V_i, HK_i, L_i, N_i, MT_i, Y_i, E_i, \epsilon_i)$.

This equation explicitly measures pathways by which maternal schooling affects child health, that is, its impact via maternal values ($V_i$), health knowledge ($HK_i$), literacy ($L_i$), numeracy ($N_i$), time spent in the home ($MT_i$) and household income ($Y_i$). Schooling itself, $S_i$, is not included in this equation because its impact is assumed to manifest itself solely through its effects on these variables, as shown in equations (4), (5'), (6'), (7'), (10) and (11).

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10. One could enter the literacy and numeracy of both parents directly into (11), which would allow one to analyze the nature of labor markets (e.g. whether credentialism is taking place). But this is not the major interest of this paper, so both terms are substituted out using (5') and (6').

Very few data sets from developing countries contain information on values ($V_i$) and skill attainment ($HK_i$, $L_i$ and $N_i$), so in most cases researchers decompose the impact of mothers' schooling into only three different factors by substituting equations (4), (5'), (6') and (7') into (8'):

$$(12) \quad H_i = h''(S_i, GE_i, V_G, A_i\text{-}S_i\text{-}6, Q_i, M_i, R_i, MT_i, Y_i, E_i, \mu_i, \epsilon_i, u_{hi}).$$

where $u_{hi}$ includes all unobservables in equations (4), (5'), (6') and (7'). Equation (12) separates the impact of maternal schooling on child health into its effects on total household income, on mothers' time spent with the child, and on the mother skills and values. Unfortunately, it cannot determine which skills are most crucial for child health.

Finally, substitution of (10) and (11) into (12) yields a complete reduced form, measuring the overall impact of mothers' (and fathers') education on child health outcomes:

$$(13) \quad H_i = h'''(S_i, S_{if}, GE_i, GE_{if}, V_G, Q_i, A_i\text{-}S_i\text{-}6, A_{if}\text{-}S_{if}\text{-}6, M_i, R_i, T_i, XF_i, HA_i, E_i, \mu \epsilon_i, u_{hi}).$$

Equations similar to (13) have been estimated in the literature, but they cannot discern what it is about mothers' education that raises child health. Much more is learned about how education raises child health by estimating equation (8'), but such estimation is seldom done due to lack of data.

This completes the formal model that underlies the empirical work in this paper. The essential points are: 1. Years of schooling and the skills and values today's parents had when they left school can be considered exogenous; 2. The values held by today's parents are exogenous because they are unlikely to change since they left school; 3. Parent's current literacy and numeracy skills can change after they leave school, but this drift can be treated as exogenous because it is largely predetermined by occupational choices made soon after leaving school, before parents had children and could observe their health endowments; 4. Parent's current health knowledge may be endogenous because it is relatively easy to change and parents have strong incentives to do so if their children have health problems; and 5. Mothers' time spent working and annual household income may also be endogenous. Chapter III shows how this model can be estimated using Moroccan data.

## III. Data and Estimation Procedures

### The Data

The 1990-91 Enquête Nationale sur le Niveau de Vie des Menages (ENNVM) was implemented by Morocco's Direction de la Statistique. The survey, which is based on the World Bank's LSMS surveys, covered 3323 households from all areas of Morocco (of the original sample design of 3360 households, 3323 were actually interviewed). For further details on the survey, see World Bank (1994b). The unique aspect of the 1990-91 ENNVM is a battery of tests given to household members in two thirds (2171) of the households. The tests included: 1. Five questions on health knowledge; 2. Twelve questions on general knowledge (how to mail a letter, how to read an electricity bill, etc.); 3. An oral mathematics test of ten questions; 4. A set of written mathematics tests of varying degrees of difficulty; 5. A set of Arabic reading and writing tests; and 6. A set of French reading and writing tests. The tests are shown in Annex I.

All persons in the 2171 selected households between the ages of 9 and 69 were to be tested except: 1. Individuals with a baccalaureate degree[11] or higher level of education took only the health knowledge test since it was assumed that they could obtain nearly perfect scores on all other tests; 2. The health knowledge test was taken only by individuals between the ages of 20 and 50. The 2171 households who participated contained 1612 children age 5 or younger, of which 81 had mothers who did not participate in the tests for one reason or another, leaving a sample of 1531 children. It is assumed that the 39 mothers with a baccalaureate degree would have received perfect scores on all the tests (except the health test, which they did take), which boosts the sample size to 1570. Dropping observations with missing values leaves a sample of 1495 children.

Table 1 provides descriptive statistics on all variables used in the analysis. The upper case letters in parentheses relate each variable to the model of Chapter II. Of particular interest are the test score variables. They show substantial variation, which is necessary to assess the underlying pathways by which mothers' schooling raises child health. In addition, the test scores should not be highly correlated with years of schooling, or with each other; if they are regression analysis cannot identify the underlying mechanisms. Table 2 shows correlation of years of schooling with the different test scores. Health knowledge is not very highly correlated with any of the other variables. Oral mathematics and French writing are more highly correlated with years of schooling, but not alarmingly so. Unfortunately, other test scores are often highly correlated with years of schooling and with each other. For example, Arabic reading and writing are very highly correlated (correlation coefficient of 0.900), as are written mathematics and Arabic writing (correlation coefficient of 0.925). Whether regression analysis can distinguish between the impacts of these different skills is thus uncertain and will become clear only by examining regression estimates.

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11. Roughly speaking, a baccalaureate degree lies somewhere between a U.S. high school degree and a college degree. It is only awarded after passing a rigorous set of examinations.

*Table 1: Descriptive Statistics of Variables Used*

| *Variable* | *Mean* | *Standard Deviation* | *Minimum* | *Maximum* |
|---|---|---|---|---|
| Height for Age Z-score ($H_i$) | -0.94 | 1.86 | -5.90 | 5.76 |
| Mother Works | 0.35 | 0.48 | 0 | 1 |
| Per Capita Expenditure ($Y_i$) | 5398.82 | 5081.68 | 809 | 56,946 |
| Sex of Child (female) | 0.53 | 0.50 | 0 | 1 |
| Age of child (in months) | 35.86 | 20.00 | 0 | 71 |
| Mothers' Height ($\epsilon_i$) | 157.02 | 6.20 | 138 | 183 |
| Fathers' Height ($\epsilon_i$) | 168.49 | 5.95 | 121 | 194.2 |
| Fathers' Height Missing | 0.31 | 0.46 | 0 | 1 |
| Mothers' Years Schooling ($S_i$) | 1.98 | 2.97 | 0 | 18 |
| Fathers' Years Schooling ($S_{if}$) | 3.14 | 4.10 | 0 | 22 |
| Health Knowledge ($HK_i$) | 2.89 | 1.57 | 0 | 5 |
| General Knowledge | 1.53 | 3.18 | 0 | 11 |
| Oral Mathematics ($N_i$) | 1.71 | 1.90 | 0 | 10 |
| Reading and Writing Mathematics ($N_i$) | 1.18 | 2.62 | 0 | 8 |
| Arabic Reading ($L_i$) | 2.33 | 4.98 | 0 | 16 |
| Arabic Writing ($L_i$) | 0.57 | 1.54 | 0 | 5 |
| French Reading ($L_i$) | 1.48 | 4.44 | 0 | 16 |
| French Writing ($L_i$) | 0.26 | 1.06 | 0 | 5 |
| Mothers' Post-School Experience ($A_i$-$S_i$-6) | 24.46 | 8.05 | 4 | 55 |
| Fathers' Post-School Experience ($A_{if}$-$S_{if}$-6) | 27.27 | 14.95 | 0 | 77 |
| Mothers' Father Schooling ($GE_i$) | 0.03 | 0.16 | 0 | 1 |
| Mothers' Mother Schooling ($GE_i$) | 0.01 | 0.10 | 0 | 1 |
| Fathers' Fathers Schooling ($GE_{if}$) | 0.02 | 0.15 | 0 | 1 |
| Fathers' Mother Schooling ($GE_{if}$) | 0.003 | 0.06 | 0 | 1 |
| Father not in Household | 0.11 | 0.31 | 0 | 1 |
| Mothers' Mother Worked ($T_i$) | 0.08 | 0.27 | 0 | 1 |
| Mothers' Mother Alive ($XF_i$) | 0.83 | 0.38 | 0 | 1 |
| Fathers' Mother Alive ($XF_i$) | 0.61 | 0.49 | 0 | 1 |
| Fathers' Father Alive ($XF_i$) | 0.40 | 0.49 | 0 | 1 |
| Rental Income ($HA_i$) | 1460.79 | 13,920.17 | 0 | 300,115 |
| Children Overseas ($HA_i$) | 0.01 | 0.09 | 0 | 1 |
| Rooms per Capita ($HA_i$) | 0.31 | 0.27 | 0 | 1.67 |
| House: Villa ($HA_i$) | 0.003 | 0.06 | 0 | 1 |
| House: Concrete ($HA_i$) | 0.24 | 0.43 | 0 | 1 |
| House: Brick ($HA_i$) | 0.43 | 0.49 | 0 | 1 |
| House: Shanty ($HA_i$) | 0.02 | 0.14 | 0 | 1 |
| Mothers' Married Sisters ($R_i$, $XF_i$) | 1.88 | 1.56 | 0 | 8 |
| Fathers' Married Sisters ($R_i$, $XF_i$) | 1.51 | 1.56 | 0 | 8 |
| Fathers' Married Sisters Missing | 0.22 | 0.41 | 0 | 1 |
| Father Born here ($XF_i$) | 0.64 | 0.48 | 0 | 1 |
| Irrigated Crop Land (hectares) ($HA_i$) | 2.36 | 12.62 | 0 | 200 |
| Unirrigated Crop Land (hectares) ($HA_i$) | 30.88 | 94.59 | 0 | 1345 |
| Tree Crop Land (hectares) ($HA_i$) | 0.32 | 1.42 | 0 | 20 |
| Number of Televisions ($M_i$) | 0.55 | 0.58 | 0 | 3 |
| Number of Radios ($M_i$) | 0.89 | 0.55 | 0 | 3 |
| Availability of Newspapers ($M_i$) | 0.21 | 0.41 | 0 | 1 |

Sample Size: 1495

*Table 2: Correlation Among Schooling and Test Score Variables of Mothers*

| | Years Schooling | Health Knowledge | General Knowledge | Oral Mathematics | Written Mathematics | Arabic Reading | Arabic Writing | French Reading | French Writing |
|---|---|---|---|---|---|---|---|---|---|
| Years Schooling | 1.0000 | | | | | | | | |
| Health Knowledge | 0.3343 | 1.0000 | | | | | | | |
| General Knowledge | 0.9045 | 0.3724 | 1.0000 | | | | | | |
| Oral Mathematics | 0.6461 | 0.4389 | 0.6458 | 1.0000 | | | | | |
| Written Mathematics | 0.8826 | 0.3522 | 0.9044 | 0.6048 | 1.0000 | | | | |
| Arabic Reading | 0.8501 | 0.4029 | 0.8784 | 0.5837 | 0.8766 | 1.0000 | | | |
| Arabic Writing | 0.9154 | 0.3314 | 0.9290 | 0.6246 | 0.9247 | 0.8997 | 1.0000 | | |
| French Reading | 0.8738 | 0.3169 | 0.8747 | 0.6183 | 0.8569 | 0.8416 | 0.9333 | 1.0000 | |
| French Writing | 0.7406 | 0.2437 | 0.6605 | 0.6142 | 0.5972 | 0.5871 | 0.6707 | 0.7243 | 1.0000 |

*Note:* All variables are in logarithms

## Estimation Procedures: General

The relationship of primary interest in this paper is equation (8'). The dependent variable used is the Z-score of child height for age, which indicates chronic malnutrition over a child's lifetime (stunting). In principle, one could also use weight for height, but the 1990-91 ENNVM weight data suffer from serious measurement error because weight was recorded only to the nearest kilogram (cf. World Bank, 1994b). Most explanatory variables discussed in Chapter II are available in the data. However, there are no variables that directly measure children's health endowments ($\epsilon_i$), maternal values ($V_i$) and tastes for work ($T_i$), and mother innate learning ability ($\mu_i$).

The inability to directly observe child health endowments ($\epsilon_i$) could lead to biased parameter estimates due to omitted variable bias or correlation with endogenous variables. This is minimized by entering the heights of both parents as explanatory variables, since taller parents are likely to have better health endowments, which in turn are inherited by their children. In addition, parents (and their children) display variation in height that is not related to health status - healthy people can vary in height. Entering parental height in the regressions controls for this as well, purging the dependent variable of variation in height that is not indicative of health status. Finally, note that fathers' height is missing for about one third of the children, either

because the father did not live with the children or was unavailable for measurement at the time of the interview. To avoid losing this portion of the sample, which could lead to sample selectivity biases, a dummy variable was created indicating that fathers' height was missing; in such cases fathers' height variable is set equal to the mean.

Maternal values ($V_i$) is the one variable that schooling may alter that is not measured in the 1990-91 ENNVM. If the effect of schooling on maternal values is important, one would expect that adding years of schooling in equation (8') would lead to a significantly positive effect. Thus, years of schooling is entered in some estimates of equation (8') to detect any effect of schooling on child health via its effect on maternal values (or on other unmeasured school-related factors). Mothers' tastes for work ($T_i$) primarily serves as an instrumental variable for mothers' time spent working; such tastes are not directly observed but can be represented by a dummy variable indicating whether her mother ever worked.

Finally, the mothers' innate learning ability ($\mu_i$) is not observed. While it is tempting to try to extract this variable by assuming that it is a fixed effect that has an impact on all test scores, it is not possible to identify such a fixed affect without making untenable assumptions (see Hausman and Taylor, 1981, for a general discussion). The inability to observe mothers' innate ability raises the possibility that the contribution of mothers' education to child health may be overestimated (since innate ability could be positively correlated with both variables). However, there is no obvious direction of bias when attempting to assess the relative importance of different pathways by which mothers' education may affect child health.

While the 1990-91 ENNVM data contain information about local health clinics and other variables pertaining to the local health environment, some of the data are missing and comparability is a problem. In addition, the sampling procedure used for choosing the health facilities covered by the survey is unclear. The 1990-91 ENNVM data also contain data on school quality in rural areas, but the range of school characteristics covered is quite limited. Moreover, these data cover current school quality, which may not represent levels of quality prevailing when today's parents were in school. Because the main interest of this paper focuses on household level variables (skills and education levels of mothers), a simple "cluster" fixed effects procedure is used to avoid bias caused by omitting community level health environment and school quality variables.[12]

As mentioned in Chapter II, health knowledge, mothers' time working outside the home and household income may well be endogenous. This is handled using two-stage least squares methods. Comparing equation (8') with equations (7'), (10) and (11) yields the following set of instrumental variables: households assets ($HA_i$); fathers' schooling and experience ($S_{if}$ and $A_{if}$ - $S_{if}$ - 6); variables on the extended family ($XF_i$) and relatives or friends with health knowledge ($R_i$); exposure to mass media ($M_i$); mothers' and fathers' parent's education ($GE_i$ and $GE_{if}$); mothers' tastes for work ($T_i$); and mothers' work experience ($A_i$ - $S_i$ - 6). Another possibility is school quality ($Q_i$), but community fixed effects estimation removes its impact. Finally, one

12. The sampled households were drawn from 140 primary sampling areas ("clusters").

could add mothers' schooling ($S_i$), but it may belong in equation (8'); this will be discussed and checked below.

While the schooling and experience instrumental variables are well defined, the other instruments must be matched to specific variables in the 1990-91 ENNVM data. Households asset variables are: 1. Three variables on agricultural land owned by the household (in hectares); 2. Household rental income (from land, buildings and durable goods); 3. The number of adult children of household members living overseas (who may send sizeable remittances); and 4. Five variables representing the value of the dwelling (rooms per capita plus four dummy variables indicating dwelling quality), if owned by the household. The extended family variables are: 1. Three dummy variables indicating whether the mothers' mother, as well as her husband's parents, are still alive;[13] 2. The number of married sisters of the mother and of her husband; and 3. A dummy variable indicating whether the husband was born in the current place of residence. The relatives and friends variables are the number of married sisters of the mother and of her husband. The media variables are: 1. The number of radios and televisions in the household; and 2. The availability of local newspapers. Mothers' tastes for work are represented by a dummy variable indicating whether her mother ever worked. Finally, note that household expenditure is used, instead of household income, because it is likely to be more accurate and more closely related to households' permanent income.

**Estimation Procedures: Decomposing the Separate Impacts of Mothers' Education**

The simplest way to assess the distinct contributions of mothers' years of schooling on child health is to assume linear functional forms for equations (4), (5'), (6'), (7'), (10), (11) and (8'):[14]

$$(4) \quad V_i = \eta_0 + \eta_1 S_i + \eta_2 GE_i + \eta_3 Q_i + \eta_4 V_G + u_{vi}$$

$$(5') \quad L_i = \gamma_0 + \gamma_1 S_i + \gamma_2 GE_i + \gamma_3 Q_i + \gamma_4 (A_i - S_i - 6) + \gamma_5 \mu_i + u_{li}$$

$$(6') \quad N_i = \delta_0 + \delta_1 S_i + \delta_2 GE_i + \delta_3 Q_i + \delta_4 (A_i - S_i - 6) + \delta_5 \mu_i + u_{ni}$$

$$(7') \quad HK_i = \beta_0 + \beta_1 S_i + \beta_2 L_i + \beta_3 N_i + \beta_4 GE_i + \beta_5 Q_i + \beta_6 (A_i - S_i - 6) + \beta_7 M_i + \beta_8 R_i + \beta_9 \epsilon_i + \beta_{10} \mu_i + u_{hki}$$

$$(10) \quad MT_i = \theta_0 + \theta_1 S_i + \theta_2 Q_i + \theta_3 GE_i + \theta_4 T_i + \theta_5 (A_i - S_i - 6) + \theta_6 XF_i + \theta_7 HA_i + \theta_8 \epsilon_i + \theta_9 \mu_i + u_{mi}$$

$$(11) \quad Y_i = \pi_0 + \pi_1 MT_i + \pi_2 S_i + \pi_3 S_{if} + \pi_4 Q_i + \pi_5 (A_i - S_i - 6) + \pi_6 (A_{if} - S_{if} - 6) + \pi_7 GE_i + \pi_8 GE_{if} + \pi_9 HA_i + u_{yi}.$$

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13. In Morocco elderly parents usually live with their sons. Thus if they are alive they are more likely than the wife's parents to substitute for mother's time at home if the mother works.

14. An error term has been added to equation (8') to reflect measurement error in the dependent variable (height for age) and inexact fit brought about by the linear functional form assumption.

(8') $H_i = \alpha_0 + \alpha_1 V_i + \alpha_2 HK_i + \alpha_3 L_i + \alpha_4 N_i + \alpha_5 MT_i + \alpha_6 Y_i + \alpha_7 E_i + \alpha_8 \epsilon_i + u_{hi}$

Substitution of (5') and (6') into (7'), of (10) into (11), and finally of (4), (5'), (6'), (7'), (10) and (11) into (8') yields a linearized version of (13):

(13) $H_i = \omega_0 + \omega_1 S_i + \omega_2 S_{fi} + \omega_3 GE_i + \omega_4 GE_{fi} + \omega_5 V_G + \omega_6 Q_i + \omega_7 (A_i - S_i - 6) + \omega_8 (A_{fi} - S_{fi} - 6) + \omega_9 M_i + \omega_{10} R_i + \omega_{11} T_i + \omega_{12} XF_i + \omega_{13} HA_i + \omega_{14} E_i + \omega_{15} \mu_{mi} + \omega_{16} \mu_{fi} + \omega_{17} \epsilon_i + u_{hi}$.

where $\omega_1 = \alpha_1 \eta_1 + \alpha_2 (\beta_1 + \beta_2 \gamma_1 + \beta_3 \delta_1) + \alpha_3 \gamma_1 + \alpha_4 \delta_1 + \alpha_5 \theta_1 + \alpha_6 (\pi_2 + \pi_1 \theta_1)$.[15]

Intuitively, equation (11') corresponds to regressing child health on the exogenous variables at the top of Figure 1 (as well as on exogenous variables not included in Figure 1). The separate pathways by which mothers' schooling raises child health are found in the various components of $\omega_1$. In particular: 1. The direct effect by which years of schooling raises health knowledge (pathway b-bc) is captured in $\alpha_2 \beta_1$; 2. The indirect increases in health knowledge caused by schooling via the literacy and numeracy attained during schooling (pathway c-c'-bc) is reflected in $\alpha_2 \beta_2 \gamma_1$ (literacy) and $\alpha_2 \beta_3 \delta_1$ (numeracy); 3. The direct effect of cognitive skills acquired in school on effective use of health inputs (pathway c-c'') is captured in $\alpha_3 \gamma_1$ (literacy) and $\alpha_4 \delta_1$ (numeracy); 4. The impact of schooling on values, which affects health inputs directly (pathway a-a'), is represented by $\alpha_1 \eta_1$; 5. The impact of schooling on time spent by the mother with the child, which could reflect increased time spent working outside the home (pathways c-c'''-cde' and d-cde') is picked up by $\alpha_5 \theta_1$; and 6. The impact of mothers' schooling on household income (pathways c-c'''-cde-cdef and d-cde-cdef) operates via its impact on mother wages and on mothers' time spent with the child (the complement of mothers' time spent working) - the former is represented by $\alpha_6 \pi_2$ and the latter by $\alpha_6 \pi_1 \theta_1$. The primary objective of this paper is to estimate these components of $\omega_1$, using appropriate econometric techniques.

15. The remaining parameters ($\omega_0$, $\omega_2$, etc.) can be similarly decomposed, but such decompositions are not shown here because the primary focus of this paper is the decomposition of $\omega_1$.

## IV. Estimation Results

### Ordinary Least Squares and Fixed Effects Estimates

Before examining the pathways by which mothers' schooling affects child health one should first verify that the Moroccan data show that such an effect exists. Table 3 presents ordinary least squares (OLS) and fixed effects (FE) estimates of equation (13), i.e. reduced form estimates of the determinates of child height for age.[16] Although the OLS and FE estimates in Table 3 are similar, and will be discussed together, specification tests favor the fixed effects specification.[17] Thus only fixed effects estimates will be presented in the remainder of the paper.

Table 3 shows that mothers' years of schooling has a significantly positive effect on child height, which is consistent with evidence from other countries (see Chapter II). This is the main finding of interest in Table 3, but a quick discussion of other variables is useful. A dummy variable for female children is negative but has weak levels of significance, yielding no strong evidence of gender discrimination in child health. Child height for age varies substantially with child age (in months); this reflects common patterns whereby malnutrition rises with age in the first two years of life (until weaning ends) but then levels off (and may even decline). Both mothers' and fathers' height are positively correlated with height for age, which picks up both variation in the child's unobserved health endowment ($\epsilon_i$) and natural variation in height among healthy children. Fathers' years of schooling is completely insignificant. This suggests no direct effect of fathers' education on child height. Perhaps a weak indirect effect exists via household income; this will be checked below. The remaining variables in Table 3 are mostly insignificant, though many have the expected signs; their main is to serve as instruments in later regressions, so further discussion here is unnecessary.

Table 4 presents estimates of a linearized version of equation (12), which is comparable to attempts in the literature to identify some of the pathways by which mothers' education raises child health. In particular, (log) per capita household expenditures and a dummy variable indicating whether the mother works are added as regressors, and those variables that affect child health only through their impacts on these two variables (specifically, $XF_i$, $HA_i$, $A_{if}$-$S_{if}$-6, $GE_{if}$ and $T_i$) are dropped. In principle, fathers' education could also be dropped since it was insignificant in Table 3 and Chapter II assumed that it affects child health only through its contribution to household income, but here it is retained to test directly whether this assumption is reasonable.

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16. All years of schooling and test score variables are specified in logarithmic form because: 1. It seems reasonable to assume that attainment of the most basic skills would have larger impact than would attainment of additional skills among persons who already have basic skills; and 2. In general, taking the logs of these variables almost always fit the data better (higher $R^2$ statistics).

17. A Hausman test of fixed effects versus the null hypothesis of random effects yields a $\chi^2$(d.f. 36) of 54.7, which is statistically significant at the 95% level. The random effects specification (not shown in Table 3, but similar to the OLS results) is favored over OLS; the Breusch-Pagan Lagrange multiplier test has $\chi^2$(d.f. 1) = 33.4, decisively rejecting the null hypothesis homoscedasticity.

*Table 3: Reduced Form Estimates of Determinants of Height for Age Z-Scores*

| | *OLS* | | *Fixed Effects* | |
|---|---|---|---|---|
| *Variable* | *Coefficient* | *t-statistics* | *Coefficient* | *t-statistics* |
| Constant | -16.902 | -10.52 | --- | --- |
| Sex (female) | -0.149 | -1.69 | -0.122 | -1.37 |
| Age (months) | -0.081 | -9.12 | -0.077 | -8.66 |
| Age$^2$ (months) | 0.001 | 7.58 | 0.001 | 7.16 |
| Mothers' Height | 0.065 | 8.63 | 0.051 | 6.09 |
| Fathers' Height | 0.040 | 5.27 | 0.043 | 5.14 |
| Fathers' Height Missing | 0.305 | 2.65 | 0.258 | 1.99 |
| Log Mothers' Schooling | 0.205 | 2.41 | 0.211 | 2.25 |
| Log Fathers' Schooling | -0.019 | -0.29 | -0.013 | -0.18 |
| Mothers' Post-School Experience | 0.004 | 0.48 | 0.008 | 0.90 |
| Fathers' Post-School Experience | 0.001 | 0.16 | -0.007 | -1.06 |
| Mothers' Father Schooling | 0.081 | 0.27 | 0.130 | 0.38 |
| Mothers' Mother Schooling | -0.697 | -1.44 | -1.209 | -2.41 |
| Fathers' Father Schooling | -0.091 | -0.28 | -0.427 | -1.19 |
| Fathers' Mother Schooling | 0.796 | 0.99 | 0.937 | 1.11 |
| Father not in Household | 0.009 | 0.03 | -0.184 | -0.50 |
| Mothers' Mother Worked | -0.030 | -0.18 | 0.177 | 0.96 |
| Mothers' Mother Alive | 0.008 | 0.07 | -0.063 | -0.50 |
| Fathers' Mother Alive | -0.057 | -0.48 | -0.230 | -1.83 |
| Fathers' Father Alive | -0.018 | -0.17 | -0.008 | -0.07 |
| Log Rental Income | 0.015 | 0.79 | -0.024 | -1.05 |
| Children Overseas | 0.380 | 0.72 | 0.307 | 0.55 |
| Rooms/Capita | -0.344 | -1.42 | -0.008 | -0.03 |
| House: Villa | 0.950 | 1.20 | 1.390 | 1.41 |
| House: Concrete | -0.056 | -0.33 | -0.055 | -0.27 |
| House: Brick | -0.147 | -0.89 | -0.086 | -0.45 |
| House: Shanty | 0.006 | 0.02 | -0.372 | -0.70 |
| Mothers' Married Sisters | -0.001 | -0.03 | 0.008 | 0.27 |
| Fathers' Married Sisters | 0.036 | 1.06 | 0.030 | 0.84 |
| Fathers' Married Sisters Missing | -0.183 | -1.02 | -0.208 | -1.08 |
| Father Born Here | 0.267 | 2.24 | 0.135 | 0.95 |
| Irrigated Crop Land | 0.000 | 0.13 | 0.001 | 0.22 |
| Unirrigated Crop Land | 0.001 | 1.94 | 0.000 | 0.76 |
| Tree Crop Land | -0.024 | -0.74 | -0.005 | -0.13 |
| Number of Televisions | 0.310 | 3.19 | 0.354 | 3.15 |
| Number of Radios | -0.031 | -0.36 | -0.032 | -0.35 |
| Availability of Newspapers | 0.090 | 0.67 | 0.325 | 1.65 |
| $R^2$ | 0.192 | | 0.317 | |

Sample Size: 1495

Table 4 presents two different estimates of equation (12): fixed effects (FE) and two stage least squares with fixed effects (2SLSFE). The two stage procedure allows one to test whether endogeneity of household expenditures and mothers' work status seriously biases ordinary FE estimates. A Hausman test of FE vs. 2SLSFE shows very little evidence of bias; the $\chi^2$(d.f. 20) statistic for this test was only 1.70, revealing no evidence of endogeneity bias.[18] Thus for the remainder of this paper both log per capita expenditures and the dummy variable indicating whether the child's mother works will no longer be instrumented.

Turn now to the results in Table 4, focusing on the FE estimates. The coefficient on mothers' years of schooling is quite similar to those in Table 3, which suggests that the main impact of mothers' education is *not* through its contribution to household income among mothers who work (not surprising since 65% of the mothers in the sample do not work). Coefficients on per capita expenditures and whether the mother works are both in the expected direction but not statistically significant (t-statistics of 1.40 and -1.64, respectively); mothers' education may indirectly improve child health by raising household income but could also lower it by reducing time spent by the mother with her children; together these two pathways tend to cancel each other out.[19] Overall, after accounting for these indirect impacts of maternal education on child health a large role remains for more direct effects of mothers' education. Finally, fathers' schooling, which was not at all significant in Table 3, remains so in Table 4. This supports the assumption that the contribution of fathers' education to child health works primarily, if not almost exclusively, through raising family income, while mothers' education alone has a substantial direct role. It also justifies the focus on mothers' (as opposed to fathers') education in the remainder of this paper.

Table 5 presents a first attempt to estimate equation (8'), the impact of specific maternal skills on child health. While equation (8') implies that one should enter all skills variables simultaneously in one regression, the high collinearity among these variables (see Table 2) suggests the more cautious approach of examining them one by one. Table 5 examines all test scores except that on basic health knowledge, which will be examined separately below due to its potential endogeneity. All regressions are fixed effects estimates, using White's (1980) heteroscedastic-consistent variance-covariance matrix.

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18. The first stage estimates for 2SLSFE are given in Table A.1 of Annex II. Many identifying variables for both log per capita expenditures (such as log rental income, rooms per capita of the dwelling, the dwelling dummy variables and irrigated crop land) and mother's employment status (such as whether the mother's mother ever worked and whether the father was born in the current place of residence) are highly significant. F-tests of the joint significance of all identifying variables yielded quite high statistics, 14.51 for the former and 2.85 for the latter. Partial $R^2$ coefficients (see Bound, Jaeger and Baker, 1993) were 0.295 and 0.122, respectively. Finally, instruments used in the first stage regressions easily pass the overidentification test of Davidson and MacKinnon (1993, pp.232-37) - the $\chi^2$(19) test statistic is 11.36.

19. Note the significant impact of mother's education on both these variables in the first stage regressions (see Table A.1 in Annex II). Yet note as well that the 2SLSFE estimates of the impact of the mother working is positive (though not significantly so) and quite large; this suggests that caution is in order when attributing a negative impact of mother's employment on child health.

*Table 4: Conditional Demand Estimates of Determinants of Height for Age Z-Scores*

| | *Fixed Effects* | | *2SLS with Fixed Effects* | |
|---|---|---|---|---|
| *Variable* | *Coefficient* | *t-statistics* | *Coefficient* | *t-Statistics* |
| Sex (female) | -0.117 | -1.33 | -0.136 | -1.49 |
| Age (months) | -0.077 | -8.78 | -0.075 | -8.17 |
| $Age^2$ (months) | 0.001 | 7.25 | 0.001 | 6.69 |
| Mothers' Height | 0.049 | 5.96 | 0.048 | 5.44 |
| Fathers' Height | 0.039 | 4.74 | 0.042 | 4.82 |
| Fathers' Height Missing | 0.265 | 2.27 | 0.305 | 2.49 |
| Log Mothers' Schooling | 0.210 | 2.27 | 0.123 | 1.02 |
| Log Fathers' Schooling | -0.009 | -0.14 | 0.034 | 0.46 |
| Mothers' Post-School Experience | 0.008 | 1.21 | 0.003 | 0.41 |
| Mothers' Father Schooling | 0.043 | 0.13 | 0.138 | 0.40 |
| Mothers' Mother Schooling | -1.212 | -2.44 | -1.374 | -2.63 |
| Number of Televisions | 0.300 | 2.74 | 0.316 | 2.43 |
| Number of Radios | -0.046 | -0.51 | -0.045 | -0.44 |
| Availability of Newspapers | 0.336 | 1.73 | 0.344 | 1.73 |
| Mothers' Married Sisters | -0.001 | -0.04 | 0.011 | 0.34 |
| Fathers' Married Sisters | 0.028 | 0.81 | 0.015 | 0.40 |
| Fathers' Married Sisters Missing | -0.182 | -1.20 | -0.193 | -1.25 |
| Mother Works | -0.195 | -1.64 | 0.640 | 0.98 |
| Log Per Capita Expenditures | 0.154 | 1.40 | 0.148 | 0.51 |
| $R^2$ | 0.313 | | 0.288 | |

Sample Size: 1495

Notes: 1. The two instrumented variables in the 2SLSFE column are mother works and log per capita expenditures. First stage estimates are given in Table A.1 in Annex II.

The first column in Table 5 examines the contribution of general knowledge. The coefficient has the expected sign but is not statistically significant at standard levels (t-statistic of 1.32). However, note that the effect of mothers' schooling on child health is completely insignificant and has the "wrong" sign. When mothers' schooling is removed from the regression (not shown in Table 5), general knowledge is statistically significant at the 5% level (t-statistic of 2.37). For the moment, it is fair to say that this variable deserves further investigation.

*Table 5: Mothers' Cognitive Skills and Child Height for Age Z-Scores*

| *Variables* | *General Knowledge* | *Oral Mathematics* | *Reading and Writing Mathematics* | *Arabic Reading* | *Arabic Writing* | *French Reading* | *French Writing* |
|---|---|---|---|---|---|---|---|
| Sex (female) | -0.109 | -0.116 | -0.102 | -0.106 | -0.100 | -0.104 | -0.112 |
| | (-1.29) | (-1.37) | (-1.20) | (-1.25) | (-1.18) | (-1.22) | (-1.33) |
| Age (months) | -0.076 | -0.075 | -0.075 | -0.075 | -0.075 | -0.076 | -0.076 |
| | (-8.35) | (-8.24) | (-8.19) | (-8.22) | (-8.22) | (-8.37) | (-8.34) |
| Age$^2$ (months) | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| | (7.17) | (7.09) | (7.04) | (7.06) | (7.09) | (7.19) | (7.19) |
| Mothers' Height | 0.050 | 0.051 | 0.051 | 0.051 | 0.051 | 0.050 | 0.051 |
| | (6.54) | (6.63) | (6.59) | (6.53) | (6.59) | (6.54) | (6.61) |
| Fathers' Height | 0.039 | 0.039 | 0.039 | 0.038 | 0.038 | 0.039 | 0.039 |
| | (5.37) | (5.34) | (5.39) | (5.15) | (5.19) | (5.40) | (5.47) |
| Fathers' Height Missing | 0.159 | 0.153 | 0.150 | 0.162 | 0.153 | 0.157 | 0.157 |
| | (1.62) | (1.56) | (1.54) | (1.64) | (1.57) | (1.60) | (1.60) |
| Log Mothers' Schooling | 0.020 | 0.165 | -0.045 | 0.119 | -0.121 | -0.035 | 0.232 |
| | (0.16) | (1.80) | (-0.37) | (1.00) | (-0.75) | (-0.29) | (2.52) |
| Log Cognitive Skill Variable | 0.146 | -0.040 | 0.240 | 0.031 | 0.423 | 0.198 | -0.288 |
| | (1.32) | (-0.38) | (2.20) | (0.37) | (1.96) | (1.93) | (-1.45) |
| Log Per Capita Expenditures | 0.218 | 0.216 | 0.198 | 0.224 | 0.238 | 0.223 | 0.231 |
| | (2.18) | (2.14) | (1.99) | (2.22) | (2.38) | (2.23) | (2.32) |
| Mother Works | -0.188 | -0.189 | -0.173 | -0.173 | -0.164 | -0.188 | -0.172 |
| | (-1.64) | (-1.64) | (-1.50) | (-1.49) | (-1.42) | (-1.63) | (-1.47) |
| $R^2$ | 0.302 | 0.301 | 0.302 | 0.302 | 0.302 | 0.302 | 0.302 |
| Sample Size | 1494 | 1488 | 1488 | 1484 | 1487 | 1495 | 1495 |

Note: All estimates include cluster-level fixed-effects. To control for heteroscedasticity, White's (1980) method is used to estimate the variance-covariance matrix. Asymptotic t-statistics are given in parentheses.

The second and third columns of Table 5 examine the role of numeracy using two separate tests, oral mathematics skills and written mathematics skills. Column 2 reveals no relationship between a mothers' ability to answer simple oral mathematics problems and child health; the parameter estimate on this variable is close to zero and has an unexpected (though completely insignificant) sign. Further, the coefficient on mothers' schooling, while slightly lower than the estimates in Table 4, remains statistically significant at the 10% level. In contrast, the ability to read and write numbers appears to have a significantly positive effect on child height-for-age (t-statistic of 2.20) and the impact of mothers' years schooling becomes negative (though insignificantly different from zero).[20] This suggests that the ability to do

20. More complex written mathematics tests were taken by 13% of these mothers, only those who scored well enough on this simple test. However, when entered as a separate regressor (not shown here) this variable showed no statistical significance.

simple mathematics operations (whether in one's head or perhaps even on paper) is of little importance—the numeracy skill that really matters appears to be reading and writing numbers correctly.[21]

The fourth and fifth columns of Table 5 examine the role played by reading and writing in Arabic, respectively. It is somewhat surprising to see that reading Arabic has an insignificant effect, although it did have the effect of reducing the mothers' education variable to insignificance as well. In column five, Arabic writing has a significantly positive impact (t-statistic of 1.96) that renders the effect of mothers' schooling negative (though insignificantly so). These results suggest that literacy in Arabic is important, although it is puzzling that writing appears more important than reading; intuitively one would think that reading is a more important skill than writing, such as reading the instructions for administering some kind of medicine.

Finally, the last two columns of Table 5 examine the ability to read and write in French, respectively. The ability to read in French is significantly positive at the 10% level (t-statistic of 1.93), rendering mothers' schooling completely insignificant. In contrast, the ability to write in French has a *negative*, though not statistically significant, effect. This last result may be spurious; note how the coefficient on mothers' education increases in size and has the largest t-statistic in Table 5. The spurious nature of this result is seen when French writing is entered without mothers' schooling (not shown in Table 5); in this case it is completely insignificant (t-statistic 0.04).

While the results in Table 5 may raise as many questions as they answer, the following tentative conclusions can be drawn. First, general knowledge about modern society learned in school may play a role; this will be examined further below. Second, while numeracy skills in general appear to be quite important, the ability to read and write numbers may be key; the ability to solve simple mathematics problems without reference to reading and writing skills has no distinct impact on child health. Third, literacy in Arabic appears to matter, though somewhat surprisingly it appears that the ability to write, not the ability to read, is what matters. Fourth, literacy in French, this time in terms of ability to read, may play an important role. Fifth, to the extent that the years of schooling variable represents values, or skills taught in school other than numeracy or literacy, there is no evidence that they are very important; this follows from the fact that years schooling often becomes completely insignificant when literacy and numeracy skills are entered in the regression. Finally, there is one result not shown in Table 5; mothers' innate ability (the estimated fixed effect) has no independent effect on child health. In particular, when this variable is added to each regression in Table 5 (not shown here) it was never statistically significant.

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21. Intuitively, reading correctly would seem to be more important, such as reading instructions on a medicine bottle (which will be examined further below). However, when the reading and writing mathematics score was split into separate subscores for reading and writing, respectively, both had strong effects when used in separate regressions. In fact, these two subscores are highly correlated (correlation coefficient of 0.962), so the data do not allow one to distinguish between them.

**Health Knowledge: Two-Stage Least Squares Estimates**

Perhaps the most obvious mechanism by which a mothers' schooling should increase her children's nutritional status is by raising her health knowledge, either by directly by teaching effective health practices or indirectly via literacy and numeracy, which allows mothers to learn about health practices on their own. As explained in Chapter III, health knowledge may not be exogenous - in particular, having a sick child may increase a mothers' health knowledge (as she inquires about treatments), so unobserved characteristics that make a child ill may also raise health knowledge, which would bias estimates of $\alpha_2$ in equation (8') downwards. The impact of mothers' health knowledge on child height for age is examined in detail in Tables 6 and 7.

Table 6 presents estimates of the impact of health knowledge on child height for age using FE and 2SLSFE specifications; the former does nothing to account for possible endogeneity of health knowledge, while the latter controls for that possibility using instrumental variable techniques. In that first two columns, FE estimates of the impact of mothers' health knowledge on child health are completely insignificant, regardless of whether mothers' education is entered as a regressor. It may be that endogeneity is biasing the parameter estimates downwards, or perhaps some of the five health knowledge questions in that short test are of little relevance for child health. The latter possibility was investigated (results not shown here) with little success; none of the five questions, when entered alone, was significant at even the 10% level.

The third and fourth columns of Table 6 provide estimates of the impact of health knowledge that attempt to account for its possible endogeneity. The key identifying instrumental variables are mothers' years of schooling, the number of televisions and radios in the home, the availability of newspapers and the number of married sisters of the mother and the father. The exclusion restriction on mothers' schooling is based on the fact that it is excluded from equation (8'), and in fact was only included in the results in Table 5 to account for unobserved impacts of schooling on values; the results in that table suggest that such effects are insignificant (schooling often loses significance when test scores are added as regressors). For purposes of comparison, the third column of Table 6 includes mothers' schooling as a variable, so that identification of mothers' health knowledge is achieved from the other identifying variables. For both specifications, joint F-tests of the instruments and the partial $R^2$ statistic of Bound, Jaeger and Baker are given.[22]

The startling finding of the 2SLSFE estimates in Table 6 is that mothers' health knowledge has a strong and statistically significant impact on child health, regardless of whether mothers' schooling is used as an instrument. The magnitude of the point estimates for this impacts is very large: a move from 1 correct answer on the health knowledge test to all five correct entails an improvement in the child's Z-score of about 1.1 points (recall that these Z-scores are points on a standard normal distribution, so that an improvement of 1.1 points can

22. The overidentification test of Davidson and MacKinnon does not reject the null hypothesis that the instruments are uncorrelated with the second stage residuals, the $\chi^2(29)$ and $\chi^2(30)$ test statistics are 33.73 and 33.58 for the regressions with and without mother's schooling, respectively.

*Table 6: Impact of Mother's Health Knowledge on Child Height for Age*

| *Variables* | *Fixed Effects* | | *2SLS with Fixed Effects* | |
|---|---|---|---|---|
| | *Including Mother's Schooling* | *Excluding Mother's Schooling* | *Including Mother's Schooling* | *Excluding Mother's Schooling* |
| Sex (female) | -0.107 | -0.107 | -0.099 | -0.098 |
| | (-1.26) | (-1.25) | (-1.09) | (-1.07) |
| Age (months) | -0.076 | -0.076 | -0.076 | -0.076 |
| | (-8.33) | (-8.32) | (-8.39) | (-8.36) |
| Age$^2$ (months) | 0.001 | 0.001 | 0.001 | 0.001 |
| | (7.21) | (7.18) | (7.04) | (7.02) |
| Mother's Height | 0.049 | 0.049 | 0.046 | 0.045 |
| | (6.63) | (6.34) | (5.21) | (5.19) |
| Father's Height | 0.039 | 0.040 | 0.039 | 0.039 |
| | (5.36) | (5.37) | (4.59) | (4.58) |
| Father's Height Missing | 0.153 | 0.145 | 0.189 | 0.187 |
| | (1.54) | (1.47) | (1.74) | (1.74) |
| Log Mother's Schooling | 0.108 | --- | 0.033 | --- |
| | (1.35) | | (0.34) | |
| Mother's Health Knowledge | 0.059 | 0.073 | 0.664 | 0.716 |
| | (0.70) | (0.88) | (1.90) | (2.28) |
| Log Per Capita Expenditures | 0.245 | 0.278 | 0.180 | 0.183 |
| | (2.40) | (2.88) | (1.61) | (1.64) |
| Mother Works | -0.207 | -0.197 | -0.210 | -0.208 |
| | (-1.80) | (-1.72) | (-1.75) | (-1.73) |
| $R^2$ | 0.303 | 0.303 | --- | --- |
| Sample Size | 1473 | 1473 | 1473 | 1473 |
| F-test of Identifying Instruments | --- | --- | 3.29 | 3.95 |
| Partial $R^2$ statistic | --- | --- | 0.223 | 0.245 |

*Notes:* 1. Estimates in column 1 and 2 use White's (1980) method to estimate the variance-covariance matrix.
2. First-stage results for 2SLSFE estimates are given in Table A.2 in Annex II.
3. Asymptotic t-statistics are given in parentheses.

move a child from the lower tail to only slightly below the median).[23] Overall, the results in Table 6 support the intuitively appealing hypothesis that basic health knowledge of mothers has a strong positive impact on child health.[24]

23. The test score variable is in natural logs, and ln(5) = 1.609.

24. The difference between the FE and 2SLSFE results raises the question of whether some or all of the skills examined in Table 5 may also be endogenous, which could lead to large differences between FE and 2SLSFE results. This was examined for all test scores shown in Table 5; the results (not given here) show no major differences between the FE and 2SLSFE results for all those scores.

A further investigation of the role of basic health knowledge on child health can be investigated using three questions from the general knowledge test on how to read the instructions on a medicine bottle (these instructions are given in Arabic). This is examined in Table 7. When these three questions are treated as a single piece of health knowledge, the impact on child health is generally significant (5% or 10% levels) for both FE and 2SLSFE specifications. The similarity between the FE and 2SLSFE results implies that it is no necessary to instrument the ability to read a medicine bottle variable (this was confirmed by a Hausman test). The statistically significant impact of this variable, if robust, may prove useful for interpreting other results.

Overall, the results in Tables 5, 6 and 7 show several possible ways by which mothers' education may improve child health. However, since many of these variables are highly correlated with each other, as seen in Table 2, some of the results may be spurious. To see which variables are genuine and which are serving as proxies for the others, Table 8 presents pairwise matchings of the following seven variables which were found to have significant impacts on child height for age Z-scores: 1. General Knowledge (minus the three medicine bottle questions); 2. Reading and Writing Mathematics; 3. Arabic Writing; 4. French Reading; 5. Health Knowledge; and 6. Reading Medicine Bottle. The following three results are the most important. First, the four cognitive skill variables (general knowledge, reading and writing mathematics, Arabic writing and French reading) show no clear dominance of one over the other. Second, the ability to read a medicine bottle does reasonably well when matched with the four cognitive skill variables in the sense that its t-statistic tends to be higher than, or at least as high as, those of the cognitive skill variables in paired matches; but still its t-statistics are not significant at standard levels. Third, and most importantly, health knowledge clearly dominates all the other variables in Table 8, suggesting that health knowledge *alone* is the direct path by which mothers' schooling leads to improved child health.

To summarize, the fundamental result of this section is that mothers' health knowledge is the mechanism by which education leads to improved child health. A second finding is of a more methodological nature: ignoring the endogeneity of mothers' health knowledge may lead to completely false inferences on its role in promoting child health, in particular it may severely underestimate the role played by maternal health knowledge.

*Table 7: Mothers' Ability to Read a Medicine Bottle and Child Height for Age*

| | *Fixed Effects* | | *2SLS with Fixed Effects* | |
|---|---|---|---|---|
| *Variables* | *Including Mothers' Schooling* | *Excluding Mothers' Schooling* | *Including Mothers' Schooling* | *Excluding Mothers' Schooling* |
| Sex (female) | -0.108 | -0.108 | -0.108 | -0.108 |
| | (-1.29) | (-1.29) | (-1.22) | (-1.23) |
| Age (months) | -0.075 | -0.075 | -0.075 | -0.075 |
| | (-8.32) | (-8.33) | (-8.44) | (-8.55) |
| Age$^2$ (months) | 0.001 | 0.001 | 0.001 | 0.001 |
| | (7.14) | (7.15) | (6.98) | (7.09) |
| Mothers' Height | 0.050 | 0.050 | 0.050 | 0.050 |
| | (6.54) | (6.54) | (5.99) | (6.10) |
| Fathers' Height | 0.038 | 0.038 | 0.038 | 0.038 |
| | (5.34) | (5.34) | (4.62) | (4.69) |
| Fathers' Height Missing | 0.159 | 0.159 | 0.159 | 0.160 |
| | (1.63) | (1.63) | (1.54) | (1.55) |
| Log Mothers' Schooling | -0.005 | --- | -0.158 | --- |
| | (-0.04) | --- | (-0.37) | --- |
| Reading Medicine Bottle | 0.146 | 0.144 | 0.295 | 0.147 |
| | (1.75) | (2.64) | (0.72) | (1.85) |
| Log Per Capita Expenditures | 0.218 | 0.217 | 0.214 | 0.216 |
| | (2.18) | (2.21) | (2.07) | (2.10) |
| Mother Works | -0.187 | -0.188 | -0.179 | -0.188 |
| | (-1.63) | (-1.64) | (-1.50) | (-1.61) |
| $R^2$ | 0.302 | 0.302 | --- | --- |
| Sample Size | 1494 | 1494 | 1494 | 1494 |
| F-test of Identifying Instruments | --- | --- | 2.33 | 58.55 |
| Partial $R^2$ statistic | --- | --- | 0.359 | 0.701 |

*Notes:* 1. Estimates in column 1 and 2 use White's (1980) method to estimate the variance-covariance matrix.
2. First-stage results for 2SLSFE estimates are given in Table A.2 in Annex II.
3. Asymptotic t-statistics are given in parentheses.

*Table 8: Paired Comparisons of Six different Test Scores*

| | *First Test Score* | | *Second Test Score* | | | |
|---|---|---|---|---|---|---|
| | *Coefficient* | *t-statistics* | *Coefficient* | *t-statistics* | $R^2$ | *Sample Size* |
| General Knowledge and Reading/Writing Mathematics | 0.094 | 0.67 | 0.131 | 1.07 | 0.302 | 1488 |
| General Knowledge and Writing Arabic | 0.043 | 0.26 | 0.232 | 1.07 | 0.302 | 1487 |
| General Knowledge and Reading French | 0.072 | 0.60 | 0.131 | 1.27 | 0.302 | 1494 |
| General Knowledge and Health Knowledge | 0.046 | 0.39 | 0.680 | 1.90 | --- | 1473 |
| General Knowledge and Reading Medicine Bottle | 0.046 | 0.27 | 0.117 | 1.02 | 0.302 | 1494 |
| Reading/Writing Mathematics and Writing Arabic | 0.092 | 0.69 | 0.171 | 0.86 | 0.302 | 1484 |
| Reading/Writing Mathematics and Reading French | 0.109 | 1.14 | 0.107 | 1.13 | 0.302 | 1488 |
| Reading/Writing Mathematics and Health Knowledge | 0.094 | 0.94 | 0.626 | 1.76 | --- | 1467 |
| Reading/Writing Mathematics and Reading Medicine Bottle | 0.113 | 1.08 | 0.088 | 1.09 | 0.302 | 1488 |
| Writing Arabic and Reading French | 0.149 | 0.88 | 0.094 | 0.82 | 0.302 | 1487 |
| Writing Arabic and Health Knowledge | 0.124 | 0.91 | 0.696 | 1.98 | --- | 1467 |
| Writing Arabic and Reading Medicine Bottle | 0.147 | 0.92 | 0.091 | 1.08 | 0.303 | 1487 |
| Reading French and Health Knowledge | 0.076 | 0.88 | 0.730 | 2.06 | --- | 1473 |
| Reading French and Reading Medicine Bottle | 0.105 | 1.09 | 0.082 | 1.07 | 0.303 | 1494 |
| Health Knowledge and Reading Medicine Bottle | 0.733 | 2.00 | 0.010 | 0.11 | --- | 1473 |

*Notes:* 1. Mothers' schooling was excluded from all regressions.
2. Health knowledge is instrumented. Reading medicine bottle is *not* instrumented.

# V. Decomposing the Impact of Mothers' Schooling on Child Health

The finding in the previous section that mothers' health knowledge plays by far the most important role in determining child health does *not* necessarily imply that literacy and numeracy do not matter. As explained in Chapter II, mothers' health knowledge may develop after leaving school, and in a way that will depend on mothers' literacy, and perhaps on numeracy as well. This section attempts to decompose the overall impact (i.e. reduced form estimate) of mothers' schooling on child health by decomposing the parameter $\omega_1$ given in equation (13) in Chapter III.

Recall from Chapter III that the overall effect of mothers' education on child health in (13), $\omega_1$, could be decomposed into $\alpha_1\eta_1 + \alpha_2(\beta_1 + \beta_2\gamma_1 + \beta_3\delta_1) + \alpha_3\gamma_1 + \alpha_4\delta_1 + \alpha_5\theta_1 + \alpha_6(\pi_2+\pi_1\theta_1)$. The results in Chapter IV indicate that the direct effect of values, literacy and numeracy on child health (i.e. the coefficients $\alpha_1$, $\alpha_3$ and $\alpha_4$) on child health were not statistically significant from zero.[25] The 2SLSFE estimates in Table 6 indicate that the impact of household income on child health (measured by $\alpha_6$) had only marginal significance (t-statistic of 1.64), with a parameter estimate of 0.165. The same regression gives a weakly significant direct impact of mother working on child health ($\alpha_5$) of -0.208. Finally, the best point estimate for the impact of health knowledge on child health is the 2SLSFE estimates of Table 6 that exclude schooling as a regressor, hence $\alpha_2$ is approximately 0.716.

To complete the decomposition of $\omega_1$ one needs estimates of $\beta_1$, $\beta_2$, $\gamma_1$, $\beta_3$, $\delta_1$ and, if one wants to incorporate the weakly significant impacts of household income and mother working, of $\theta_1$ and $\pi_2 + \pi_1\theta_1$. Table A.1 in Annex II provides a point estimate of 0.094 for $\theta_1$, and the coefficient of mothers' schooling in the first regression in that table provides an overall estimate of 0.133 for $\pi_2 + \pi_1\theta_1$. The remaining parameter estimates are shown in Table 9, which provides estimates of equations (5'), (6') and (7'). The first two columns present structural estimates of the determinants of health knowledge, equation (7'), as opposed to the reduced form estimates given in Table A.2 in Annex II. Assuming that these parameter estimates are unbiased, the regression in column 1 shows that the two most important skills that have a positive impact on health knowledge are reading Arabic and oral math skills. None of the remaining skills variables has a statistically significant positive impact. Because these different skills variables are highly correlated, as well as highly correlated with mothers' schooling, more precise estimates can be obtained by dropping insignificant variables and variables with implausible signs (in particular, writing Arabic and years of schooling).[26] This produces the second column of estimates in Table 9, which indicate that $\beta_2$ (where L represents reading ability

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25. Regarding the literacy and numeracy effects, while the results in Table 8 show positive effects of three literacy and numeracy variables (reading/writing mathematics, writing Arabic and reading French) on child health when paired health knowledge, the associated t-statistics were insignificant (around 0.8). A regression using health knowledge and all three of these variables (not shown here) resulted in health knowledge still being statistically significant at the 10% level but the other variables had very low t-statistics (0.34, 0.13 and -0.48). Thus it seems reasonable to assume that $\alpha_3$ and $\alpha_4$ equal zero.

26. By dropping years of schooling it is assumed that $\beta_1 = 0$.

in Arabic) is about 0.103 and $\beta_3$ (where N represents the ability to simple arithmetic in one's head) is about 0.204. Finally the last two columns of Table 9 give estimates of equations (5') and (6'), which yield $\gamma_1$ and $\delta_1$: 1.074 and 0.438, respectively.

Combining all these results provides two alternative estimates of $\omega_1$: 0.143, if one excludes the imprecisely estimated direct impacts on child health of household income and mother working, and 0.147 if one includes their effects. While these are rather crude estimates (for example, no interaction terms are used), they are within the same range as the fixed effects estimate of $\omega_1$ from Table 3, 0.211. This decomposition of $\omega_1$ implies that the mechanism by which mothers' schooling improves child health is the following: mothers' schooling directly raises Arabic literacy and simple mathematics skills, both of which contribute to *post-schooling* acquisition of health knowledge, which is the essential skill that enables mothers to provide better health care for their children. There may also be small impacts due to better educated mothers contributing to household income and being more likely to work, but these two effects tend to cancel each other out. These results suggest that direct teaching of health care practices in schooling would greatly improve the ability of mothers to provide for their children, but at the same time they also indicate that such skills are not directly taught in Moroccan schools (since the estimate of $\beta_1$ is not significantly different from zero).

*Table 9: Regressions for Decomposing Impact of Mothers' Schooling on Child Health*

| | *Dependent Variables* | | | |
|---|---|---|---|---|
| *Independent Variables* | *Mothers' Health Knowledge* | | *Arabic Reading* | *Oral Mathematics* |
| Log Mothers' Schooling | -0.115 | --- | 1.074 | 0.438 |
| | (-2.16) | | (29.68) | (14.99) |
| Reading Arabic | 0.254 | 0.103 | --- | --- |
| | (5.57) | (4.64) | | |
| Reading French | 0.012 | --- | --- | --- |
| | (0.25) | | | |
| Writing Arabic | -0.273 | --- | --- | --- |
| | (-2.54) | | | |
| Writing French | -0.078 | --- | --- | --- |
| | (-1.41) | | | |
| Oral Mathematics | 0.277 | 0.204 | --- | --- |
| | (6.36) | (5.28) | | |
| Reading/Writing Mathematics | 0.044 | --- | --- | --- |
| | (0.78) | | | |
| Mothers' Mother Schooling | -0.214 | -0.248 | -0.069 | -0.114 |
| | (-1.90) | (-2.48) | (-0.55) | (-0.49) |
| Mothers' Father Schooling | -0.023 | -0.32 | -0.141 | 0.185 |
| | (-0.28) | (-0.40) | (-1.62) | (1.80) |
| Mothers' Post-School Experience | -0.001 | 0.001 | -0.004 | -0.000 |
| | (-0.57) | (0.23) | (-2.24) | (-0.23) |
| Mothers' Height | 0.004 | 0.004 | --- | --- |
| | (1.51) | (1.42) | | |
| Fathers' Height | 0.002 | 0.001 | --- | --- |
| | (0.80) | (0.27) | | |
| Fathers' Height Missing | -0.066 | -0.055 | --- | --- |
| | (-1.52) | (-1.25) | | |
| Number of Televisions | 0.080 | 0.080 | --- | --- |
| | (2.11) | (2.09) | | |
| Number of Radios | -0.022 | -0.024 | --- | --- |
| | (-0.67) | (-0.70) | | |
| Availability of Newspapers | 0.175 | 0.182 | --- | --- |
| | (2.71) | (2.81) | | |
| Mothers' Married Sisters | 0.017 | 0.017 | --- | --- |
| | (1.64) | (1.63) | | |
| Fathers' Married Sisters | -0.008 | -0.005 | --- | --- |
| | (-0.70) | (-0.47) | | |
| Fathers' Married Sisters Missing | -0.022 | -0.017 | --- | --- |
| | (-0.38) | (-0.28) | | |
| $R^2$ | 0.479 | 0.461 | 0.816 | 0.599 |
| Sample Size | 885 | 890 | 907 | 909 |

*Notes:* 1. All regressions are cluster fixed effects, using White's (1980) method to correct for heteroscedasticity.
2. All test score variables are in logs.
3. Asymptotic t-statistics are given in parentheses.

## VI. Summary and Conclusion

Three major conclusions can be drawn from the empirical work in this paper. First, health knowledge is by far the most important skill that mothers (indirectly) obtain from their schooling that ultimately enables them to better provide for their children's health. Second, estimating the impact of health knowledge on child health could suffer from substantial endogeneity bias that can underestimate its true impact if one does not instrument the health knowledge variable. Third, it appears that the way schooling contributes to mothers' health knowledge in Morocco is rather indirect - health knowledge is not directly learned in school but instead is learned using literacy and numeracy skills acquired in school.

The above conclusions have direct policy implications for Morocco. First, they suggest that health knowledge should be directly taught in Moroccan schools. They should be taught at an early age because girls who drop out early may never acquire sufficient numeracy and literacy skills to allow them to acquire health knowledge on their own. Many girls in Morocco leave school at a very early age; only 28% of women aged 18-20 in the 1990-91 ENNVM continued their schooling beyond primary school. Even more disturbing is that 51% of these women never attended school at all - this latter fact suggests the need for a major effort to teach young women basic health knowledge in adult education programs.

These results and their policy implications may well apply to other developing countries. If the finding that health knowledge is the key skill for improving child health applies to other countries (which is plausible and should be addressed in future research), any country where a large proportion of women do not go beyond primary school should add basic health education to its primary school curriculum. In addition, if a large proportion of women do not even attend primary school, health education programs for women of child-bearing age should also receive high priority. Finally, the findings in this paper support two general policy recommendations for developing countries: 1. Education of girls should be a high priority; and 2. School quality must be ensured, since women will not be able to raise their level of health knowledge after their schooling is completed if they leave school without basic literacy and numeracy skills.

## Annex I: Description of Tests

I. Health Knowledge Test (5 questions) to be given in the respondent's maternal language.

1. Is it possible to get vaccinations for children without paying any money? If yes, where?
   (Answer: Yes, at public hospitals, Red-Cross centers, or visits by nurses to villages).

2. What should one do to a wound to avoid infection?
   (Answer: Wash it well with soap, apply alcohol and cover it).

3. What is the best way to prevent children from getting polio?
   (Answer: Vaccination).

4. If a child develops diarrhea, what should one do if no doctor is available?
   (Answer: Use boiled water, feed rice or carrots, give salts, avoid milk and fats).

5. In places where the water is not safe to drink, what should one do to it before drinking?
   (Answer: Boil it or add drops of "javel").

II. Test of General Knowledge (12 questions)

1. On the national identity card, show the name of the person to whom it belongs.

2. On the national identity card, show the expiration date of the card.

3. On a letter, show the address of the person who sent the letter.

4. On a letter, show the address of the person to who the letter is addressed.

5. On a box of medicine, where does it show how many pills are in the box?

6. On a box of medicine, where are the instructions for using the medicine?

7. On a box of medicine, where is the date of expiration indicated?

8. For a newspaper, where is the date of the paper?

9. For a newspaper, where is the price of the paper?

10. For a newspaper, where is the article concerning...?

11. On an electricity bill, indicate the name of the person who the bill is for.

12. On an electricity bill, indicate the amount of the bill.

III. Oral Mathematics Problems (Form A).

1. Jamal buys 3 kilos of mandarin oranges at the market. His father buys 5 kilos. Altogether, how many kilos of mandarin orange do they buy? (Answer: 8 kilos).

2. Potatoes cost 30 rials per kilo. Mina has bought 4 kilos. Altogether, how much has she spent to buy potatoes? (Answer: 120 rials).

3. Aicha sells baskets at the souk. This morning she had 28 baskets, and she sold 17 of them. How many baskets does she still have? (Answer: 11 baskets).

4. Rachid had 48 dirhams that he wanted to give in equal amounts to his six children. How many dirhams will each child receive? (Answer: 8 dirhams).

5. How many meters are in 3 kilometers? (Answer: 3000 meters).

6. How many liters are contained in 500 centiliters? (Answer: 5 liters).

7. A rectangular area 50 meters long and 20 meters wide - how many meters of fencing are required to fence it in? (Answer: 140 meters).

8. Suppose a car consumes 12 liters of gasoline per 100 kilometers. How much gasoline is needed to go 300 kilometers? (Answer: 36 liters).

9. A woman puts 150 dirhams in the bank, at a 10% annual rate of interest. After one year, how much interest will she earn? (Answer: 15 dirhams).

10. A man buys 60 square meters of land for 1200 dirhams. What is the price per square meter? (Answer: 20 dirhams).

IV. Written Mathematics (Reading and Writing Numbers)

Four items for Reading Numbers:

4
62
317
8509

Four items for Writing Numbers (which were read aloud to respondents in Arabic):

6
27
538
1902

(ex-a) كُوبٌ

(ex-b) فِيلٌ

(1) نَقَلَ

(2) ثِيَابٌ

(3) أَنْفٌ

(4) نَافِذَةٌ

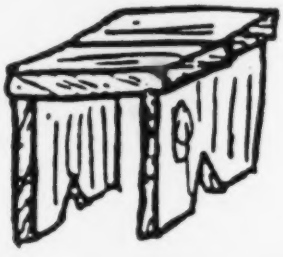
(5) مَكْتُوبٌ

(6) طَائِرٌ

(7) حَمَّامٌ

(8) مُهَنْدِسٌ

(ex-a)



كُرْسِيٌّ  بِنْتٌ

(ex-b)

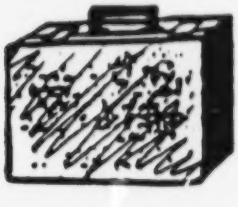
كَلْبٌ  بَيْضَةٌ

(1)

3

قَامَ  رَقْمٌ  صَخْرٌ  حَرْفٌ

(2)



سَافَرَ  حَقْلٌ  حَقِيبَةٌ  حَفْلَةٌ

(3)

حَطَبٌ  نَهَارٌ  بَابٌ  نَجَّارٌ

(4)

اَلْهَائِلُ اَلْهَاتِفُ أَسْلَكُ اَلتِّلِيفِزَافُ

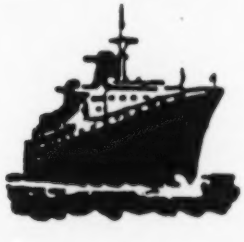
(5)

سَجِينٌ جُنْدِيٌّ سَحَابٌ طَلِيقٌ

(6)

اَلْخَيْمَةُ اَلنَّارُ اَلْحُمَّةُ اَلْحَائِطُ

(7)



سَفِينَةٌ طَائِرَةٌ سَفِينٌ دُخَّانٌ

(8)

عَنِيفٌ رِسَالَةٌ ذُبَابَةٌ عَنْكَبُوتٌ

(ex-a) **mot**

(ex-b) **par**

---

(1) **soupe**

(2) **voiture**

(3) **nombre**

(4) **marteau**

(5) **leçon**

(6) **fenêtre**

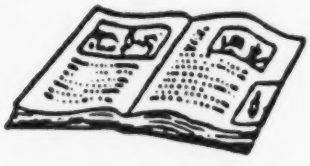
(7) **remède**

(8) **environs**

(ex-a)

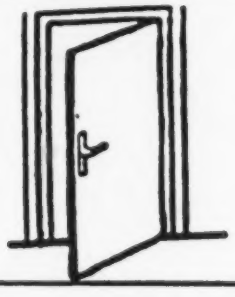
table chaise tableau dattes

(ex-b)



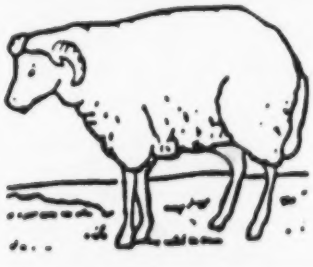
tapis cuivre ardoise livre

(1)



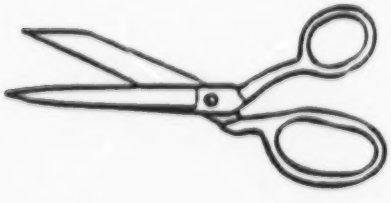
jambe porte fenêtre poule

(2)



arbre singe bouton mouton

(3)



ciseaux jeune tenailles travaux

(4)

marmite punition théière soupière

(5)

chien sucre coq cage

(6)

dispute fête discute utile

(7)

balance emploi thermomètre maitre

(8)

tour accident accord alimentation

Arabic writing

.1 ثَوْب

.2 رِسَالَة

.3 مَفْتُوح

.4 تَسْغِير

.5 إقْتِصَاد

French writing

1. lapin
2. coupure
3. premier
4. attention
5. mécanicien

52

# Annex II: Supplementary Tables

*Table A1: Fixed Effect Estimates of Determinants of Log Per Capita Expenditures and Whether Mother Works*

| | *Log Per Capita Expenditures* | | *Mother Works* | |
|---|---|---|---|---|
| *Variable* | *Coefficient* | *t-statistics* | *Coefficient* | *t-statistics* |
| Sex (female) | -0.029 | -1.41 | 0.020 | 0.99 |
| Age (months) | -0.002 | -1.20 | -0.003 | -1.38 |
| Age$^2$ (months) | 0.000 | 1.16 | 0.000 | 1.41 |
| Mothers' Height | 0.008 | 4.26 | 0.002 | 1.02 |
| Fathers' Height | 0.003 | 1.56 | -0.003 | -1.65 |
| Fathers' Height Missing | -0.003 | -0.11 | -0.044 | -1.49 |
| Log Mothers' Schooling | 0.133 | 6.18 | 0.094 | 4.45 |
| Log Fathers' Schooling | 0.053 | 3.13 | -0.044 | -2.65 |
| Mothers' Post-School Experience | -0.002 | -1.27 | 0.004 | 1.95 |
| Fathers' Post-School Experience | -0.003 | -1.76 | 0.000 | 0.14 |
| Mothers' Father Schooling | 0.210 | 2.69 | -0.114 | -1.49 |
| Mothers' Mother Schooling | -0.049 | -0.43 | 0.172 | 1.51 |
| Fathers' Father Schooling | -0.216 | -2.61 | -0.010 | -0.12 |
| Fathers' Mother Schooling | 0.221 | 1.14 | 0.069 | 0.36 |
| Father Not in Household | -0.106 | -1.26 | 0.083 | 1.00 |
| Mothers' Mother Worked | -0.046 | -1.08 | 0.118 | 2.81 |
| Mothers' Mother Alive | 0.028 | 0.97 | -0.005 | -0.18 |
| Fathers' Mother Alive | -0.050 | -1.72 | -0.043 | -1.49 |
| Fathers' Father Alive | 0.007 | 0.25 | -0.065 | -2.56 |
| Log Rental Income | 0.011 | 2.06 | 0.010 | 2.04 |
| Children Overseas | 0.111 | 0.87 | 0.010 | 0.08 |
| Rooms/Capita | 0.715 | 11.52 | -0.084 | -1.38 |
| House: Villa | -0.183 | -0.81 | -0.084 | -0.38 |
| House: Concrete | -0.420 | -8.99 | -0.016 | -0.35 |
| House: Brick | -0.405 | -9.21 | 0.008 | 0.18 |
| House: Shanty | -0.368 | -2.98 | -0.197 | -1.62 |
| Mothers' Married Sisters | 0.010 | 1.37 | -0.016 | -2.30 |
| Fathers' Married Sisters | 0.023 | 2.75 | 0.018 | 2.20 |
| Fathers' Married Sisters Missing | -0.039 | -0.89 | -0.013 | -0.29 |
| Father Born Here | -0.070 | -2.12 | 0.077 | 2.36 |
| Irrigated Crop Land | 0.005 | 5.49 | 0.002 | 1.81 |
| Unirrigated Crop Land | 0.000 | 1.41 | 0.000 | 1.89 |
| Tree Crop Land | 0.013 | 1.56 | 0.008 | 0.95 |
| Number of Televisions | 0.198 | 7.65 | -0.018 | -0.69 |
| Number of Radios | 0.107 | 4.97 | -0.013 | -0.63 |
| Availability of Newspapers | 0.036 | 0.78 | -0.013 | -0.28 |
| $R^2$ | 0.693 | | 0.469 | |

Sample Size: 1495

*Table A2: Fixed Effects Estimates of Health Knowledge and Ability to Read a Medicine Bottle*

| | *Health Knowledge* | | *Reading a Medicine Bottle* | |
|---|---|---|---|---|
| | *Coefficient* | *t-statistics* | *Coefficient* | *t-statistics* |
| Sex (female) | -0.017 | -0.65 | -0.009 | -0.34 |
| Age (months) | -0.002 | -0.60 | -0.003 | -1.02 |
| Age$^2$ (months) | 0.000 | 0.30 | 0.000 | 1.14 |
| Mothers' Height | 0.005 | 1.83 | 0.001 | 0.58 |
| Fathers' Height | 0.001 | 0.56 | 0.001 | 0.37 |
| Fathers' Height Missing | -0.061 | -1.56 | -0.018 | -0.46 |
| Log Mothers' Schooling | 0.113 | 3.87 | 1.009 | 35.26 |
| Log Fathers' Schooling | 0.054 | 2.45 | 0.065 | 2.97 |
| Mothers' Post-School Experience | 0.001 | 0.37 | -0.001 | -0.29 |
| Fathers' Post-School Experience | -0.000 | -0.15 | 0.001 | 0.34 |
| Mothers' Father Schooling | 0.087 | 0.81 | 0.118 | 1.14 |
| Mothers' Mother Schooling | -0.323 | -2.13 | -0.179 | -1.19 |
| Fathers' Father Schooling | -0.071 | -0.65 | -0.058 | -0.53 |
| Fathers' Mother Schooling | -0.029 | -0.11 | -0.323 | -1.28 |
| Father Not in Household | -0.000 | -0.00 | 0.198 | 1.80 |
| Mothers' Mother Worked | 0.103 | 1.85 | -0.113 | -2.04 |
| Mothers' Mother Alive | 0.032 | 0.84 | -0.012 | -0.31 |
| Fathers' Mother Alive | 0.007 | 0.19 | 0.030 | 0.81 |
| Fathers' Father Alive | -0.10 | -0.29 | 0.051 | 1.52 |
| Log Rental Income | -0.001 | -0.13 | -0.004 | -0.59 |
| Children Overseas | -0.048 | -0.29 | -0.293 | -1.76 |
| Rooms/Capita | 0.299 | 3.52 | 0.255 | 3.01 |
| House: Villa | -0.092 | -0.31 | -0.418 | -1.42 |
| House: Concrete | -0.098 | -1.56 | -0.060 | -0.95 |
| House: Brick | -0.311 | -5.27 | -0.132 | -2.24 |
| House: Shanty | -0.342 | -2.13 | -0.221 | -1.37 |
| Log Per Capita Expenditures | 0.049 | 1.36 | -0.045 | -1.26 |
| Mother Works | 0.036 | 0.99 | -0.018 | -0.51 |
| Mothers' Married Sisters | 0.015 | 1.59 | -0.003 | -0.36 |
| Fathers' Married Sisters | -0.014 | -1.28 | 0.023 | 2.10 |
| Fathers' Married Sisters Missing | 0.002 | 0.03 | -0.001 | -0.02 |
| Father Born Here | 0.077 | 1.79 | 0.079 | 1.85 |
| Irrigated Crop Land | 0.000 | 0.26 | -0.000 | -0.11 |
| Unirrigated Crop Land | -0.000 | -1.94 | -0.000 | -1.30 |
| Tree Crop Land | -0.034 | -3.18 | -0.011 | 1.05 |
| Number of Televisions | 0.029 | 0.83 | 0.065 | 1.89 |
| Number of Radios | -0.020 | -0.72 | -0.028 | -0.98 |
| Availability of Newspapers | 0.183 | 3.10 | 0.052 | 0.87 |
| $R^2$ | 0.446 | | 0.772 | |
| Sample Size | 1473 | | 1494 | |

## References


Barrera, Albino. 1990. "The Interactive Effects of Mothers' Schooling and Unsupplemented Breastfeeding on Child Health." *Journal of Development Economics*, 34:81-98.

Behrman, Jere. 1990. *The Action of Human Resources and Poverty on One Another: What We Have Yet to Learn*. Living Standards Measurement Study Working Paper No. 74. World Bank, Washington, D.C.

Behrman, Jere, and Anil Deolalikar. 1988. "Health and Nutrition", in Chenery and Srinivasan, eds., *Handbook of Development Economics*, Vol. I:631-711.

Bound, John, David Jaeger, and Regina Baker. 1993. *The Cure Can Be Worse than the Disease: A Cautionary Tale Regarding Instrumental Variables*. Technical Paper No. 137. National Bureau of Economic Research. Cambridge, MA.

Cash, Richard A. 1983. "Oral Rehydration in the Treatment of Diarrhea: Issues in the Implementation of Diarrhea Treatment Programs." in Chen and Scrimshaw, eds., *Diarrhea and Malnutrition: Interactions, Mechanisms, and Interventions*. Plenum Press: New York.

Cebu Study Team. 1991. "Underlying and Proximate Determinates of Child Health: The Cebu Longitudinal Health and Nutrition Study." *American Journal of Epidemiology*, 133(2):185-201.

Cebu Study Team. 1992. "A Child Health Production Function Estimated from Longitudinal Data." *Journal of Development Economics*, 38:323-51.

Davidson, Russell, and James MacKinnon. 1993. *Estimation and Inference in Econometrics*. Oxford: Oxford University Press.

Gibson, Rosalind. 1990. *Principles of Nutritional Assessment*. Oxford: Oxford University Press.

Hausman, Jerry, and William Taylor. 1981. "Panel Data and Unobservable Individual Effects." *Econometrica*, 49:1377-1398.

Schultz, T. Paul. 1984. "Studying the Impact of Household Economic and Community Variables on Child Mortality." *Population and Development Review*, 10(supplement):215-35.

Strauss, John. 1990. "Households, Communities and Preschool Child Nutrition Outcomes: Evidence from Côte d'Ivoire." *Economic Development and Cultural Change*, 38(2):231-61.

Strauss, John, and Duncan Thomas. 1995. "Human Resources: Household Decisions and Markets," in Srinivasan and Behrman, eds., *Handbook of Development Economics*, Vol. III.

Thomas, Duncan, John Strauss, and Maria Helena Henriques. 1990. "How Does Mothers' Education Affect Child Height?" *The Journal of Human Resources*. XXVI(2).

White, Halbert. 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," *Econometrica*, 48:817-838.

Wolfe, Barbara, and Jere Behrman. 1987. "Women's Schooling and Children's Health: Are the Effects Robust with Adult Sibling Control for the Women's Childhood Background?" *Journal of Health Economics*, 6:239-54.

World Bank. 1994a. *Kingdom of Morocco, Public Expenditure: Issues and Outlook*. Middle East and North Africa Region, World Bank, Washington, D.C.

World Bank. 1994b. "Morocco 1990-91 Living Standards Measurement Study Documentation." Policy Research Department, World Bank, Washington, D.C.

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